

# DAIRY MOVING FORWARD



**RESEARCH, DEVELOPMENT AND EXTENSION  
PRIORITIES FOR THE AUSTRALIAN DAIRY INDUSTRY**

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**Dairy Moving Forward is the dairy industry response to the Primary Industries Ministerial Council National Primary Industries Research, Development and Extension framework. The Dairy Moving Forward Steering Committee comprises representation from Australian Dairy Farmers, Dairy Australia, Department of Primary Industries Victoria, Australian Dairy Products Federation, the Gardiner Foundation, the Australian Council of Deans of Agriculture, United Dairyfarmers of Victoria and Regional Development Programs.**

## Introduction

### National Primary Industries Research Development and Extension Framework

Through the Primary Industries Ministerial Council (PIMC), the states and Northern Territory, rural Research & Development Corporations, CSIRO, and universities are jointly developing the National Primary Industries Research, Development and Extension (RD&E) Framework to encourage greater collaboration and promote continuous improvement in the investment of RD&E resources nationally.

This initiative was developed on the basis that Australia's primary industries cannot afford a fragmented or duplicative RD&E system if they are to continue to be sustainably productive. Australia's approximately \$1.6 billion annual RD&E investment in primary industries needs to be focussed, used efficiently, effectively and collaboratively. The framework provides the structure and institutional arrangements needed to strengthen national research capability and better address cross sectoral and sectoral research and development.

The Dairy Moving Forward (DMF) process is the dairy industry's response to the PIMC initiative. The DMF initiative is to ensure that the dairy industry will have a more coordinated and collaborative approach to RD&E and that national research capability will be focussed, used efficiently, and effectively to achieve the best outcome and uptake by the industry.

The governance of DMF is through the DMF Steering Committee. The DMF Steering Committee is Chaired by Australian Dairy Farmers and comprises:

- › Australian Dairy Farmers
- › Australian Dairy Products Federation
- › Dairy Australia
- › Department of Primary Industries Victoria
- › Geoffrey Gardiner Foundation
- › Universities involved in Dairy Research
- › Regional Development Victoria\*
- › Regional Development Programs
- › United Dairy Farmers Victoria.

### Identifying the key investment priorities for the dairy industry

Between June and October 2010, the dairy industry reviewed the investment priorities for Research, Development, Extension and Education for the next five years. This process built on earlier work and refined priorities around five key investment areas for the next five years around the industry agreed mission critical areas of: feedbase and nutrition, animal performance, people, farm business management and natural resource management and climate change (Dairy Moving Forward—A National Research and Extension Strategy, September, 2009).

To identify the priorities for each of the key five areas, extensive industry consultation was conducted drawing expertise from a wide range of industry participants. Each of the five areas was led by a Program Management Team. This team identified the key "experts" to contribute to the development of the plan. These experts were brought together as a number of consultative groups and the process included a number of face to face workshops. In all more than 150 experts representing over 50 organisations contributed to the project.

This consultation process has ensured that the industry has clarity around the key areas that had previously been identified. The work has resulted in highlighting specific areas of need and has attached desired outcomes required from each of these areas of investment. An assessment of capability and/or gaps around these priorities was also made.

The Program Management Team has documented the findings of this work and these are the basis for this report. The DMF process will continue to the next phase where the industry will determine the most effective way to organize itself to deliver on these priorities.

*\* Regional Development Victoria provided early support to the Steering Committee but has since discontinued its involvement*



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# DAIRY MOVING FORWARD

Feedbase and animal nutrition

## FEEDBASE & ANIMAL NUTRITION RD&E STRATEGY



## Acknowledgements

**This National Strategy for Dairy RD&E in ‘Feedbase and Animal Nutrition’ has been developed as an activity of Dairy Moving Forward—a dairy industry initiative to develop a strategy and capability plan to guide pre-farmgate RD&E. It has involved extensive stakeholder consultation with representatives from the dairy industry, government, and the providers and funders of dairy RD&E.**

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## 1. Executive Summary

Low cost production of home grown pastures and forages has underpinned the competitive advantage of Australian dairy farmers in global milk production. Productivity gains are needed in the production of home grown feeds and in the conversion of these resources and brought in supplements into milk protein and fat to maintain this advantage. This challenge is addressed in this Feedbase & Animal Nutrition R&D Strategy, which has been developed in the context of the increasingly complex environment in which dairy farmers operate.

The industry outcome sought from this strategy is:

*'An increased percentage of farm businesses achieving **greater than 5% real RoA** from their business (excluding capital gain) through improved management of their feedbase & feeding system by 2025.'*

The Feedbase & Animal Nutrition RD&E Strategy is built around four sub-strategies developed to provide the knowledge, technology and know how needed by farmers operating within the five nominal feeding system categories identified by the industry and in different regions. These categories are:

- Type 1: Pasture + other forages + up to 1.0 t grain or concentrates/cow fed in the dairy.
- Type 2: Pasture + other forages + >1.0 t grain or concentrates/cow fed in the dairy.
- Type 3: Pasture + partial mixed ration (PMR) on a feed pad ± grain / concentrate fed in the dairy.
- Type 4: Hybrid (pasture grazed < 9 months/yr + PMR ± grain / concentrate fed in the dairy, with a TMR or supplements fed at other times).
- Type 5: Total mixed ration (TMR) (zero grazing).

**Sub-strategy 1**, 'To develop better forages for use on dairy farms' is particularly relevant to farm types 1 to 4, and is also applicable to feedlots where efficient forage production from land used for effluent disposal can be integral to profitability.

**Sub-strategy 2**, 'To increase the efficiency and flexibility of growing and utilising forages in changing circumstances' underpins the success of all farm types. Increased variability in climate, changes in the availability of irrigation water and increasing scrutiny of nutrient use and losses from farms is requiring farmers to make productivity gains in forage production. There is a broad understanding of the management and production of pasture species and crops, but farmers need to now, compared with the past, make more decisions on the mix of forages grown to cope with the changed operating environment.

**Sub-strategy 3**, 'To optimise<sup>1</sup> feed conversion efficiency on dairy farms' recognizes that the optimum varies between feeding system types, and that combining home grown and brought in feeds to better meet the nutrient requirements of cows will improve conversion of these resources into milk protein and fat.

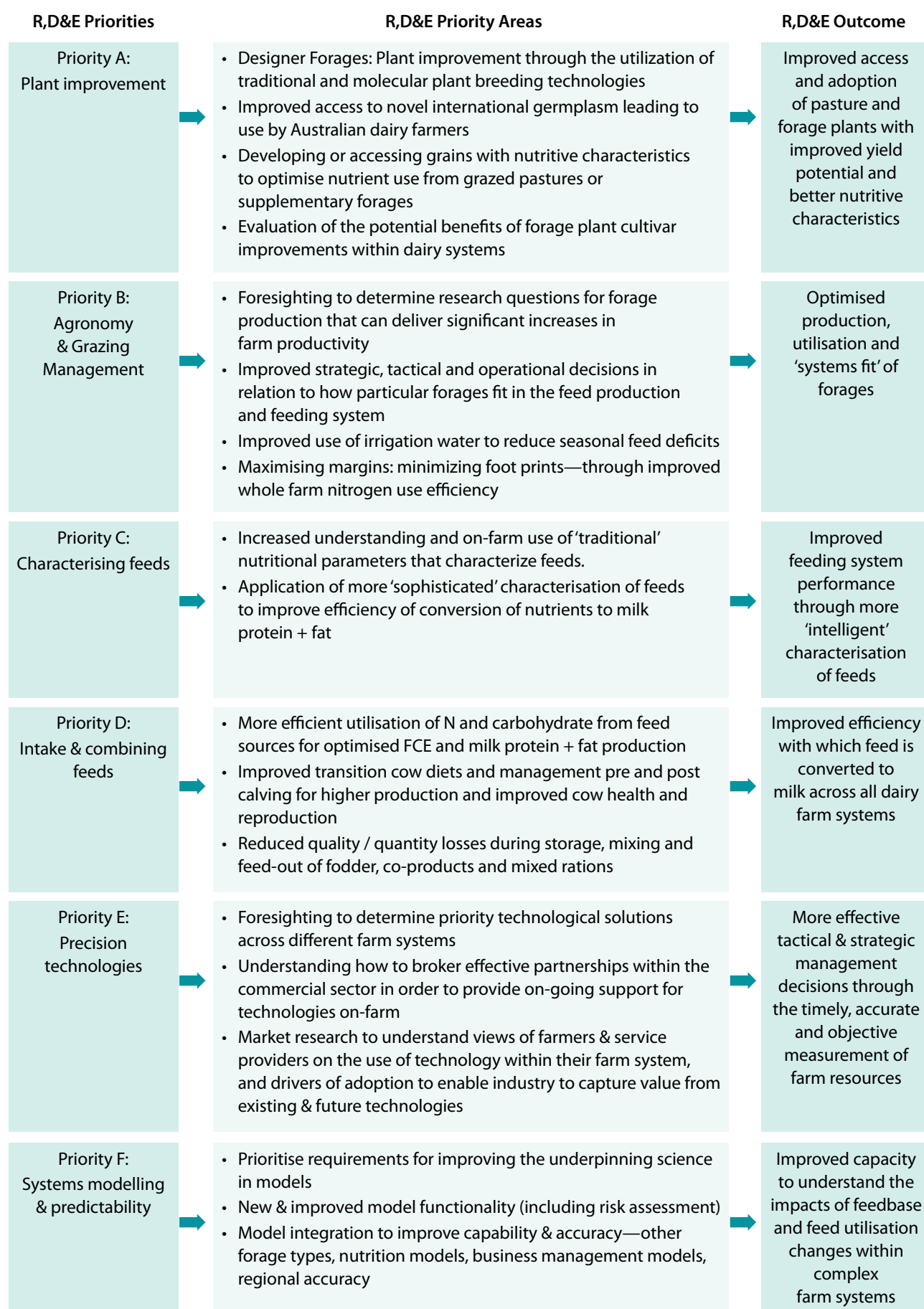
**Sub-strategy 4**, 'To increase the focus on whole farm business systems (including risk management) analysis & operations' recognizes that any changes to the feedbase or feed utilisation components of farm systems will impact on other elements of the business, with ultimate effects on returns and risk. Only by considering the whole farm system and understanding the complex interactions that occur can an intervention or innovation be fully evaluated—biophysically, socially and economically. This sub-strategy is intimately linked to the Farm Business Systems Strategy.

There are six interdependent R&D areas designed to contribute to the delivery of the strategy outcome. These are summarized in the Figure at right.

Interdependencies with the Farm Business Systems, Animals, Natural Resource Management and People Strategies are highlighted in the body of the Strategy and its attachments.

<sup>1</sup> Optimize in this context means achieving a feed conversion efficiency that leads to best or near best profit, recognising that diminishing returns occur in biological systems.

Figure 1. RD&E priority areas and outcomes for the strategy



## 2. Context for the development of the feedbase & animal nutrition strategy

Feedbase refers to the production of home grown feeds and to the brought in feeds and additives used in dairy production systems. Animal nutrition refers to feed intake and the digestion and utilisation of energy-yielding substrates and essential nutrients in feeds for maintenance and productive functions.

Australian dairy farmers face continued and increasing competition for resources, land, water, feeds, fertilisers and labour. They operate in a 'first world' country seeking to compete internationally, with flow on effects in the costs of production relating to issues in compliance, regulation, workforce and nutrient use issues. This means farmers need to manage the costs of production as well as achieving 'real' productivity improvements. At the same time, milk price and input cost volatility, uncertainty about the magnitude and impacts of climate change and variability, water scarcity (both rainfall and irrigation), and increased global competition have contributed to an increasingly complex operating environment (Dairy Australia 2010a). The decline in the terms of trade will continue, necessitating continued productivity gains to maintain or increase farm profit. Against this background, significant opportunities exist, particularly with expanding Asian markets, but to capture the potential benefits farmers may need to be more flexible in their strategic (longer term), tactical (within season) and operational (day to day) decisions.

### 2.1. Home grown pasture

At farm level, the competitive advantage of Australian dairy farmers in global milk production has been largely based on low cost of production and utilisation of home grown pastures and forages. Pasture still usually comprises 40-100% of the diet of lactating cows in Victoria (Department of Primary Industries 2009). In 2008-09 in Victoria, 55% of the metabolisable energy (ME) consumed by the lactating cows came from grazed pastures in the south-west compared with less than 40% in northern Victoria. Despite this feed costs have always been a high proportion of the variable and total costs on farms. For example, feed costs were estimated to be 70 to 95% of variable costs, and 37 to 69% of total costs (variable plus overhead costs) in a survey in Victoria (Department of Primary Industries 2007). In Queensland, the home grown forage systems are generally more diverse with about 42% of farmers considering their forage base to be pasture dominant, 38% crop dominant and 20% having a similar emphasis on both (D.G. Barber, M.N. Callow, G.J. Busby unpublished data). On average,

about 60% of the diet on Queensland farms comes from forage. Farm profitability has been shown to be positively correlated with home grown feed consumption in consultancy group and industry benchmarking and in modeling studies in southern (e.g. Chapman et al. 2008; M. Staines personal communication) and northern (e.g. Busby et al. 2006) Australia. However, it is important to recognize that other factors are also important contributors to the variation in profit at any particular point in such relationships, as illustrated by generally low correlation coefficients. Achieving high consumption of home grown feed in isolation to getting other aspects of the farm system right will not lead to better profit. This is indicated by the considerable variation around the lines of best fit in relationships between home grown feed consumption and profit, which indicates that farms are operating at different places on a response curve, on different response curves and/or that other factors are important.

There are vast differences in climate across the different dairy regions in Australia. Four broad feedbase regions were identified some time ago (Mason 1993), namely cool temperate, Mediterranean, inland irrigation, and subtropical regions. Because of the geographical spread, there is great variability in rainfall, access to irrigation water and farming systems between and within these feedbase zones, which have significant impacts on the feedbase itself and how it is used by farmers. In addition, climate change will impact to different degrees depending on the feedbase, for example increased temperatures may impact less in systems based on C4 plants compared with those based on C3 species.

Over the past 2 decades, there has been valuable R&D into pasture plant breeding, the agronomy (pasture renovation, fertiliser and irrigation responses) and grazing management of different pasture species. However, getting it 'right' in the context of an individual farm remains a challenge because of variability in management skills, the operating environment and weather conditions, but also because compromises are inherent in good pasture management. For example, it is not possible to optimise growth, nutritive characteristics and consumption of pasture at the same time. The interactions between plants and grazing animals are important to subsequent plant growth and the nutrients animals derive from grazed pasture.

## 2.2. Increasing diversity in home grown feeds

More recently, competition for land and labour, reduced rainfall and access to irrigation water and the increased use of purchased feeds has led to the investigation of a range of complementary forage systems. These systems have the potential to significantly increase home grown feed production and utilisation, but compromises and new skills are required to capture benefits from the increasing use of double or multiple cropping systems. It is important to realise that maximising production in any one aspect of a farm system (e.g. DM produced/ha) will not correspond with maximum profit. In any production response curve the law of diminishing returns will eventually apply, where the costs of extra production will eventually exceed extra returns. In reality, farmers will also have goals other than profit, which may relate among other things to labour savings, reduced stress and convenience.

## 2.3. Optimising milk protein + fat production from home grown feed & supplements

In recent years, reduced rainfall and increased cost and reduced availability of irrigation water to support home grown pastures/forages have been countered by the increased use of purchased feeds to maintain or increase milk production per cow or per farm. Overall, this has been associated with a diminishing relative contribution of home grown feed within some key regions. However, such diversity of feeding systems was evident before the 2002-03 drought, with energy consumption of the milking herd on irrigated dairy farms varying between 100% pasture or home grown feed and no bought-in feed, to 25% pasture and 75% bought-in feed in the mid 1990s (Armstrong et al. 1998).

Without doubt, optimising home grown feed production and utilisation will remain central to profitable milk production from the diverse range of farming systems that now exist. As the diversity of the dairy feedbase increases, applied research will be needed to capture the benefits of new technologies and products, by determining the 'fit' at a component and systems level. Equally more effective development and extension will be needed for farmers to capture the benefits of knowledge and technologies generated in the broad range of current and recent R&D activities. All stakeholders will need to evaluate and discuss the relative gains likely to be achieved from generating more R outputs compared with investing more heavily in information provision and support for implementation of

existing knowledge. This balance or tension is considered qualitatively in the 'route to market' subsections of Section 6 of the strategy.

The use of purchased supplements has increased in all dairy regions since the 1980s, with multiple objectives: improved pasture utilisation and digestibility through increased grazing pressure (stocking rate); increased per cow production to capitalize on advances in genetic potential; and increased milk production per hectare. Farm systems have recently been classified into types based on feeding practices as:

- Type 1: Pasture + other forages + low grain / concentrate (up to 1.0 t/cow) fed in the bail;
- Type 2: Pasture + other forages + mod-high grain / concentrate (>1.0 t/cow) fed in the bail;
- Type 3: Pasture + partial mixed ration (PMR) +/- grain / conconcentrate feeding in bail;
- Type 4: Hybrid – type 1 or 2 or 3 during the growing season and total mixed ration (TMR) or supplements at other times; and
- Type 5: Total mixed ration (Dairy Australia 2009).

Considerable R&D has been undertaken in Australia into the interactions between cows, supplements and grazed pasture when low to moderate amounts of grain are fed in the dairy. Substitution, the reduction in pasture intake for each kg of supplement consumed, is relatively well understood for the traditional perennial ryegrass-based systems. However, the negative and positive interactions (affecting ME available from the diet and the efficiency of nitrogen utilisation) that occur when concentrate supplements are fed to grazing cows, are less well defined and ultimately affect the efficiency of conversion of feed into milk and marginal responses to more supplement. These interactions are particularly important when high amounts of grain are fed in system Types 2, 3 and 4. The proportion of farms with system Type 3 has increased over the last decade, but there is a relative dearth of information internationally on the interactions between cows, supplements, grazed pasture and other grazed forages in such systems. In contrast, there is a wealth of international information on TMR systems.

Requirements for management skills increase as the complexity of feed production and utilisation systems increases and there are requirements for investment in plant and infrastructure related to feeding systems needed to optimize the use of supplementary feeds. Increased intensity of production has implications for financing and for volatility of returns (risk). For example, while the use of purchased supplementary feed

(when reasonably priced) has generally been seen as a competitive advantage of Australian compared with New Zealand dairy farmers, Thorrold and Doyle (2007) concluded that while benefits had been captured on many farms, inappropriate use has adversely affected profit on other farms.

Feed grain demand in Australia has been increasing at over 4% per annum, which is faster than grain production growth (Spragg 2008). The dairy industry is a major player in the feed grain supply chain using around 28% of feed grain sold nationally. This means that competition for feed, and impacts of growing conditions on grain production lead to considerable fluctuations in price. Similarly, competition for and supply of purchased fodder also results in variable prices.

Increasing supplementary feed use has undoubtedly contributed to the increasing complexity of strategic, tactical and operational decision making on farms of all types. An imperative, therefore, is to assist farmers in understanding emerging systems, the nutritional impacts

and tradeoffs of various combinations of feed and how diet formulation and presentation impacts animal performance. This then needs translation into a system-wide knowledge of the effects on milk production and composition and cost of production – against which profit and risk can be measured.

## 2.4. Milk supply

The Dairy Moving Forward (DMF) vision of a profitable, internationally competitive and sustainable dairy industry is predicated on maintaining or increasing milk supply. Effective farm management of feedbase and supplement use is integral to milk supply. Milk company performance is influenced to a large degree by plant capacity utilisation, throughput, product mix and product yield. In the short term competition for supply will provide farmers with opportunities, while in the longer term any erosion of supply is likely to lead to plant rationalisation, and possibly industry contraction.

*The opportunity is increased flexibility and system and business performance; the threat is margin loss and milk loss.*

## 3. Developing the feedbase & animal nutrition strategy

The DMF initiative is developing a national pre-farmgate RD&E Strategy and Capability plan for the Australian dairy industry. In March 2009, it was agreed that 3 modules of work be undertaken:

- Module 1: drafting the strategy which will identify priority outcomes, and the goals and objectives of dairy RD&E.
- Module 2: examining approaches to align dairy RD&E investment so as to implement the strategy and capability plan.
- Module 3: focus on practice change to build capability for the future, with a particular emphasis on improved extension.

*The Dairy Moving Forward: A National Research Development & Extension Strategy* report (September 2009) provided the strategic context and strategic priorities for the RD&E strategy. Five strategic priorities were developed for consideration, namely:

- **Feedbase:** Developing the skills and knowledge that allow retention and management of an internationally competitive feedbase in a changing climate.
- **Animals:** Improving animal performance.
- **Farm Business Systems:** Assisting farm businesses to adapt to a demonstrably more volatile business/ climatic environment; developing the skills of farmers to manage that volatility.

- **People:** Increasing the skills and capacity of people; aggressively developing industry education and training options.

Sustainable Natural Resources: maintaining access to key production resources.

The agreed vision in this report is:

***‘The need to create a profitable, internationally competitive and sustainable dairy industry’.***

In March 2010, the Feedbase priority had been expanded to include animal nutrition and a preliminary ‘Feedbase and Animal Nutrition’ R&D strategy (Attachment 1) was presented to the DMF committee. The outcomes, 4 strategy objectives and 6 R&D priority areas (theory of action) described in the preliminary strategy were examined and greater detail captured in the process described below.

Existing information was harvested through:

- Examination of some existing dairy industry strategies and priorities through discussion with key individuals or through accessing documents (see Attachment 2).
- Compiling information from current and recently completed R&D projects (see Attachment 3).
- Review of previous priority setting exercises in relation to supplementary feeding and feed systems RD&E (see Attachment 4).



- Examination of the Peverill and Oates (2010) report 'A Dairy Moving Forward Summary Report for Updating the Human Resource Capability and Infrastructure Data for Dairy RD&E in Australia' (Attachment 5).

Two workshops specific to 'Feedbase and Animal Nutrition' were conducted on the 8th and 12th July 2010, with participants consisting of 'subject experts' in a range of disciplines. Both workshops reviewed the theory of action in the March 2010 draft of the 'Feedbase and Animal Nutrition' strategy (Attachment 1) and considered R&D capability for the dairy industry in disciplines related to 'Feedbase and Animal Nutrition'. The first workshop considered gaps in knowledge requiring R&D in 'feed composition, animal nutrition and related precision farming technologies', while the second considered 'plant breeding, forage production and related precision farming technologies', with the intent of adding detail to the draft strategy.

In essence, the participants operated as expert reference panels to review the theory of action (outcomes, strategies and research priority areas) proposed in the strategy draft and provided detail in relation to the R&D required to deliver the strategic outcome. They had

access to the draft of the strategy, the list of current and recent R&D projects (Attachment 3), the 2002 National Dairy Alliance Feed Systems Prospectus (Attachment 4) and an extract from the Peverill and Oates (2010) report for one week prior to the workshops. Participants also reviewed the workshop reports (Attachment 6).

The workshops did not consider priorities in 'whole systems modelling' and it was planned to further develop this area as a cross strategy priority in conjunction with Farm Business Systems.

Following the workshops, a detailed draft of the strategy was prepared and reviewed by Joe Jacobs and Ron Prestidge (DPIV) and Dave Henry and Steve Coats (DA) prior to presentation at a cross area workshop.

The draft strategy was circulated to the leaders of Program 1 'Designer forages' in the Dairy Futures CRC, and to those leading the development of the Farm Business Systems and People Strategies. Relevant comments in the feedback provided were incorporated in a revised draft.

The process for further refinement of the strategy will include presentations to key stakeholders, such as dairy companies, and to the DMF steering committee.

## 4. Implications of feedbase and animal nutrition for competitiveness of the dairy industry

### 4.1. Implications at the national level

The shared vision of the stakeholders in DMF is '**a profitable, internationally competitive and sustainable dairy industry**'. For this to be achieved there must be net benefits that are shared throughout the Australian Dairy Supply Chain. The estimated current value at farmgate is \$3.7 billion, processing \$12 billion, export \$2.9 billion (DMF, 2009). Employment in farm production is estimated at 25,000, post farm processing at 15,500 and indirect employment at 100,000.

Milk used for fresh product in the Australian market is produced across the nation, while production of milk for manufacturing of export products is focused in south east Australia. It is estimated milk for manufacturing of export products comprises approximately 45% of total production. The volume of world trade in dairy products is not large (7% of estimated production) with New Zealand accounting for 28% of world traded product (milk equivalents), the European Union 31% and Australia 9%. This is despite milk production in Australia and New Zealand representing around 5% of world production. The volatility in dairy commodity prices has major effects

on farm business performance, but it is predicted, that while volatility will remain, these commodities will trade in higher price ranges than has historically been the case (DMF, 2009).

The dairy industry has important strategic linkages with other industries. For example, it:

- Comprises 10% of the beef industry.
- Uses 25–30% of grain (both down spec product and purpose grown grains) sold as livestock feed.
- Receives services from mixed farm businesses in stock agistment and conserved fodder production.
- Provides services to other industries through the use of feed co-products, brewers grains and horticultural wastes.
- Is a significant user of road and sea freight (3rd largest agricultural export industry).
- Is integral to the justification of infrastructure development (transport and irrigation) in key regional areas.

## 4.2. Implications at farm level

The decline in the terms of trade of dairy farmers will continue, necessitating continued productivity gains to maintain or increase farm profit. This is magnified as the industry seeks to be competitive from a 'first world' basis, where it meets community requirements in relation to compliance, regulation, workforce issues and in nutrient use. More than other countries, 'first world' countries need to seek better ways to create a margin, with the productivity challenge particularly acute in relation to costs. In addition, volatility in farm gate milk prices and input costs will continue.

The competitive advantage of Australian dairy farmers in global milk production has been largely based on low cost of production and utilisation of home grown pastures and forages. Feed costs have always been a high proportion of the variable and total costs on farms (up to 75%), but farm profitability is often positively correlated with home grown feed consumption when industry benchmarking data is examined (e.g. Red Sky analysis in different regions).

Increasing competition for land and water, coupled with more variable rainfall, are driving the need for further increases in home grown feed production and utilisation. Questions are being asked as to how the pasture-based systems in different regions can be improved further or combined with complementary forage systems to maintain competitive advantage.

While *optimising* home grown feed production and utilisation will remain central to profitable milk production from the diverse range of farming systems that now exist, there is also a need to better utilize brought-in supplements. Effective supplementation of grazing dairy cows is a challenge that is somewhat unique to farmers in Australia, as much lower amounts of supplementary feeds are used in other traditional pasture-based systems in Ireland and New Zealand. There is diversity in the views on nutrient supply from pastures and supplements and of milk production responses to particular feeding strategies amongst nutritionists and advisers. Not surprisingly, this has left many farmers confused.

To remain profitable, *dairy farmers will need to drive further productivity gains* from their feedbase and imported feeds, a challenge that will involve greater flexibility in their strategic (longer term), tactical (within season) and operational (day to day) decisions. Decisions will need to be taken with an understanding of risk, and how they impact across the whole farm business system.

## 4.3. Implications for companies

Consumer confidence in the domestic market is high, with robust dairy consumption (DMF, 2009). However, after a sequence of years of below average rainfall farmer confidence remains weak limiting supply growth, with implications for export companies. Milk production is currently around 9.00 billion L, down from a high of 11.27 billion L in 2001–02. Farm numbers have declined since 2001–02 from 11,048 to 7,924 in 2008/09 with cow numbers falling from 2.1 to 1.6 million over the same period. This decline has resulted in competition between companies for supply, and challenges in growing new markets.

Effective farm management of feedbase and supplement use is integral to milk supply. Milk company performance is influenced to a large degree by utilisation of plant capacity, throughput, product mix and product yield. The amount of product manufactured from every litre of milk purchased is critical, with losses occurring during transport, in processing, and through milk quality impacts, such as out of spec losses. There are significant impacts of changes in milk quality and composition on process efficiency, yield and product texture. The current rapid level of innovation in processing is enabling greater flexibility in product mix and companies will be aware that changes to the feeding systems on farms lead to changes in milk characteristics. This will impact on their decisions in relation to product mix.

Competition for supply has and will in the short term provide farmers with opportunities, while in the longer term any erosion of supply is likely to lead to plant rationalisation. This is important in terms of the vision of DMF of an internationally competitive and sustainable industry, which can only be achieved in the long term if farm businesses are truly profitable. The varied feedbase provides farmers with a unique ability to be resilient as they shift from feed opportunity to feed opportunity (water to grain, to maize, to mixed ration feeding etc). If farmers can learn to manage this opportunistic approach to their feedbase well, they can capture a competitive and sustainability advantage.

## 5. Program logic for the feedbase & animal nutrition strategy

### 5.1. Industry outcome

The logic path for the 'Feedbase and Animal Nutrition' RD&E strategy is summarized in Figure 2. The industry outcome is '*an increased percentage of farm businesses achieving **greater than 5% real RoA** from their business (excluding capital gain) through improved management of their feedbase & feeding system by 2025.*'

It has been derived from the draft strategy presented to the DMF steering committee in March 2010, and a process of subsequent review of the logic path in the draft strategy. The outcome focuses on increasing the profitability of farm businesses through better management and utilisation of the feedbase achieved over a 15 year period.

It is important that the metrics for measuring progress towards this outcome are established as quickly as possible. The baseline situation needs to be established so the outcome can be made more specific and measurable.

The logic behind an outcome focused on profit is that the Industry vision is for a profitable, internationally competitive and sustainable industry. It is unlikely the industry can be internationally competitive and sustainable if farm businesses are not profitable, and the resilience of farm businesses is based on their capacity to maintain a margin in the face of changing circumstances.

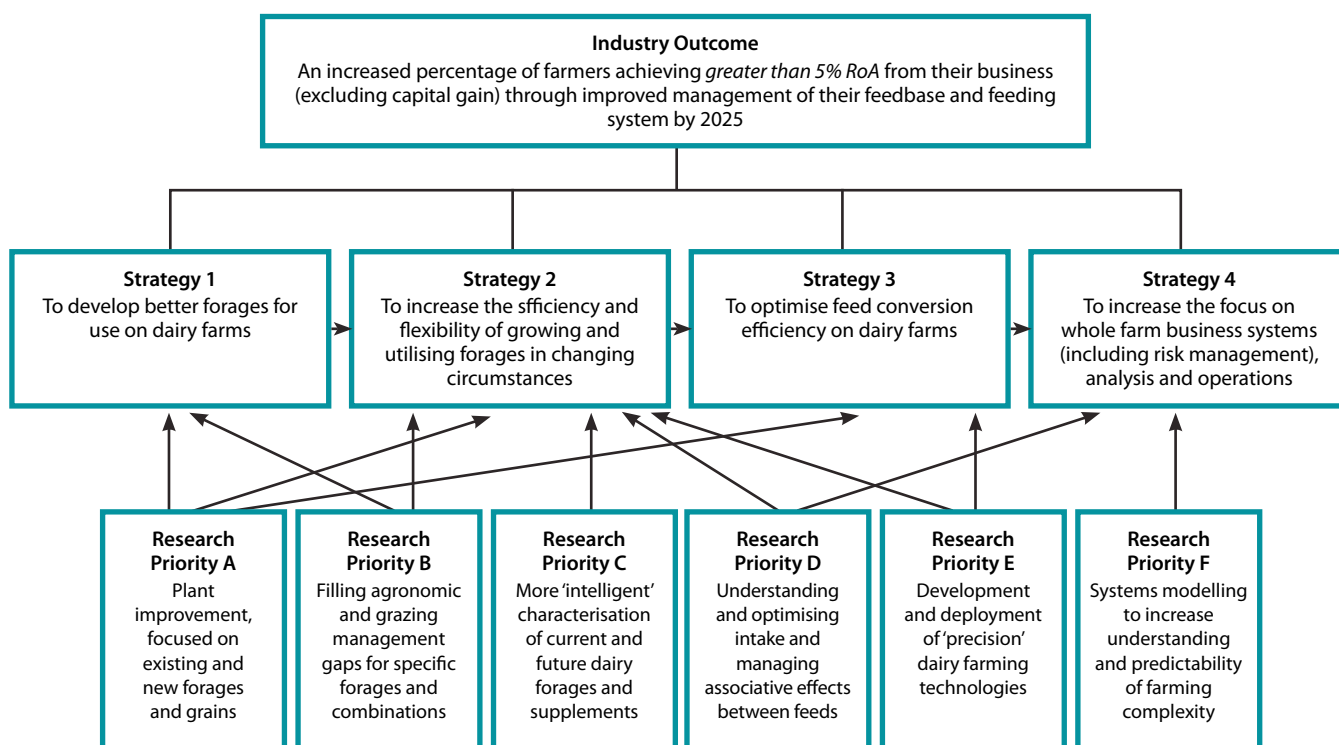
It is acknowledged the outcome is subject to external influences, in particular global factors determining milk prices and input costs, and there will be considerable variation in RoA of dairy farm businesses from year to year, necessitating measurement based on trends over time.

### 5.2. Sub-strategies

The four sub-strategies needed to deliver this outcome have been reviewed in a number of forums (the DMF steering committee and two workshops), and all are seen as integral to success. These sub-strategies are clearly not independent and a strong focus must be maintained on achieving productivity gains in whole farm systems to counteract the effects of continuing declines in terms of trade. Hence, there is an integral link to the 'Farm Business Systems' strategy. This is important as the outcomes generated by activities within 3 of the sub-strategies relate to partial productivity gains (e.g. increased pasture consumption per hectare; increased milk protein + fat production per cow or per hectare; reduced feed costs per kg protein +fat produced) and a focus on maximising such individual measures will not deliver the best profit results for farm businesses.

These four sub-strategies are also inextricably related to the 'Animals', 'Natural Resource Management', and 'People' priority areas. An example of linkages, is the

Figure 2. Logic path for the 'Feedbase and Animal Nutrition' RD&E strategy



understanding of nutrient and water inputs and cycling within a farming system to optimise both productivity and natural resource outcomes. Linkages to other strategies are highlighted throughout Section 6.

Each strategy was considered in relation to the five broad feeding system categories currently being used by the dairy industry, namely:

- Type 1: Pasture + other forages + up to 1.0 t grain or concentrates/cow fed in the dairy.
- Type 2: Pasture + other forages + >1.0 t grain or concentrates/cow fed in the dairy.
- Type 3: Pasture + partial mixed ration (PMR) on a feed pad  $\pm$  grain / concentrate fed in the dairy.
- Type 4: Hybrid (pasture grazed < 9 months/yr + PMR  $\pm$  grain / concentrate fed in the dairy, with a TMR or supplements fed at other times).
- Type 5: Total mixed ration (TMR) (zero grazing).

### Sub-strategy 1: To develop better forages for use on dairy farms

For all dairy farming systems in Australia, forage production and nutritive value underpins the ability of dairy farmers to keep costs per kg milk protein + fat relatively low. For farming systems 1 to 4 home grown forage consumption is the principal biophysical driver of profit. Effectively and efficiently growing and utilising these home grown forages, even when concentrates make up a significant proportion of the total ration, will remain a critical success factor for dairy farmers.

In feed lot systems (type 5), forage is an integral component of rations, and land is required for effluent disposal. In those feedlot businesses producing their own forage, efficient feed production using available land and excreta can be integral to profitability.

Therefore, continually 'improving' the forages available to dairy farmers remains a high priority for R&D.

### Sub-strategy 2: To increase the efficiency and flexibility of growing and utilising forages in changing circumstances

Consistent and reliable production and utilisation (grazing and conservation) of high quality forages, despite changing climatic conditions and/or irrigation availability underpins the success of all farming system types. Increased variability in climate, including extreme events, changes in the availability/reliability of irrigation water and increasing scrutiny of nutrient use and losses from farms is requiring farmers to make efficiency gains in forage production. Whilst there are still R priorities in this area, improved D&E based on current knowledge can drive such efficiency gains.

Changes in the operating environment also require an increased range of forage production options that will provide flexibility and resilience (constant and reliable high performance) in the feedbase. Flexibility in the context of this strategy refers to making decisions on the mix of forage types grown on farms to enable sensible strategic and tactical management decisions to be made as circumstances change. Improved timeliness of decision making, will require increased confidence in predictions of future scenarios.

A broad understanding of the management and production of crops and pastures and how they might be integrated exists. However, further RD&E on the incorporation of pastures, complementary forages and legumes (either with improved persistence in a mixed sward, or grown as monocultures) into farming systems is needed to provide farmers with flexibility. This does not relate to more pasture and fodder crop experiments, but to how particular pastures and crops can be integrated with brought in supplements. The use of greater diversity in the forage systems implemented on farms will require more of a focus on the synchronicity (timing) of different feeds being consumed to optimise feed conversion efficiency (Sub-strategy 3).

### Sub-strategy 3: To optimise feed conversion efficiency on dairy farms

This goal is common across the five feeding system types, with two objectives:

- To improve the efficiency of conversion of feed to milk protein + fat in the context of each feeding system type, and
- To use a deeper understanding of the principles underpinning improvements in FCE, to inform how to best use home-grown forage and purchased feeds to improve profit.

Potential FCE is lower in pasture-based systems than in feedlots, due primarily to constraints to feed intake in grazing systems. It is not sensible in any system to try to maximize FCE, but rather optimize it to maximize the economic performance of the whole system. Target FCEs will vary between the five system types and will depend on the circumstances of individual businesses.

The range of potential tactics to improve FCE (and the optimum FCE) will vary across the different farming systems types and regions. In all systems the potential to gain efficiencies from positive associative effects between feeds and how to reduce negative associative effects between feeds requires improved understanding (R). At the same time, there is already sufficient knowledge to improve milk production responses to supplementary feeds, particularly on farms utilising systems 1, 2 and 4, indicating a focus on effective D&E is needed.

The nutritive characteristics of supplementary feeds impact on FCE. For example, grain characteristics affect the utilisation of forage and milk production response to the total diet, and the industry should continue exploring options to source grains with desirable characteristics through local breeding programs or from overseas germplasm. In addition, understanding the nutritive characteristics of co-products (alternative feeds) and their impact on milk protein + fat production and farm profit is of increasing importance as farmers search for lower cost inputs.

#### Sub-strategy 4: To increase the focus on whole farm business systems (including risk management) analysis & operations

Any changes to the feedbase or feed utilisation components of farm systems will have effects on other elements of the business. An increased focus of how components are integrated at the whole farm level is

required because the farm and farmer are an integrated 'package'. Only by considering the whole farm system and understanding the complex interactions that occur, can an intervention be fully evaluated – biophysically, socially and economically. It is imperative in such evaluations that the approaches to analysis acknowledge and include marginal response principles.

A focus on whole farm understanding will also help to better focus R&D projects and capability. This strategy is intimately linked to the 'Farm Business Systems' program and is underpinned by a range of processes, methodologies and tools, of which modelling will be key component to design and evaluate R&D across farm systems and environments.

There is a clear need for agreed terminology in relation to risk and for an agreed approach(es) to assessing risk at both the component and systems level across the Farm Business Systems and People areas and this strategy.

## 6. Research & development themes

Each strategy area is underpinned by several Research<sup>2</sup> & Development<sup>3</sup> priority areas which describe in further detail how the desired outcomes will be achieved (Figure 2).

The 6 'research priority' areas outlined below for feedbase improvement are presented as separate items. This is despite the fact that they are clearly not independent of each other (or of the 'Animals' Natural Resource Management', 'Farm Business Systems' and 'People' areas) and a strong focus must be maintained on the whole farm system, while exploring the possibilities within any single research priority.

The suggested priorities or options for future RD&E in each area will require further development and analysis, including of the costs and likely benefits, before programs of work are implemented.

### 6.1. (A) Plant improvement, focused on existing and new forages and grains

#### Statement of need

To make the productivity gains necessary to counteract declining terms of trade, dairy farmers, in particular those who have approached optimization of their current system, require access to pasture and forage plants with improved DM yield potential and better nutritive characteristics. R&D in pasture plant improvement (encompassing selection, breeding, and genetic improvement) should be focused on:

- Improvements in plant genetics that can deliver specific improvements in the overall DM production and nutritive characteristics of pastures to contribute to sub-strategies 1, 2 and 3
- An expansion of the scope for genetic gains, beyond the historical DM yield and digestibility increases, including:
  - Changing seasonal curves of forage availability and nutritive characteristics
  - Increased rooting depth for improved access to water and nutrients
  - Improved 'efficiency' of photosynthesis and water use
  - Improved nutritive characteristics of C4 grasses through decreased lignin concentration, increased water soluble carbohydrate concentrations, and increased production in lower temperature environments.

<sup>2</sup> **Research** – the establishment, design, conduct, analysis and publication of scientific experiments that test hypotheses & generate new knowledge, understanding & technologies. Research establishes the principles or mechanisms underpinning responses. It involves replication to measure variation in responses. It also involves review of what is known to better formulate research questions / hypotheses, and science publication of results.

<sup>3</sup> **Development** – can be thought of as scale out of research findings. Development activities could include non-replicated trials, non-replicated farm-let studies, farm monitoring and benchmarking activities and case studies. Modelling farming systems outcomes, including risks, would be a development activity, whereas the development of new models would be a research activity.



Improvements in forage plant or grain crop characteristics that are associated with increased production and nutritive characteristics would also contribute to productivity gains through reduced feed costs, better feed conversion efficiencies (sub-strategy 3) and increased profit.

### Rationale

Investment by key stakeholders in pasture plant improvement over the past decade has seen the formation of a world class scientific team, with expertise across the traditional pasture plant genetics and breeding and newer biosciences (functional genomics), and access to state of the art infrastructure. Program 1, 'Designer forages', in the Dairy Futures CRC has been developed following comprehensive consultation with industry including a broad-based industry forum (held in February 2009) and representation from key players in the forage genetics supply industry, as well as comprehensive independent economic modelling of key traits.

Estimated rates of annual improvement in forage DM yield from traditional breeding programs are around 0.5%, but vary from 0 to 1.5%. The Dairy Futures CRC has not set a target for rates of gain in plant genetic improvement, but some estimates suggest the rate of improvement for DM yield may be tripled (ie from 0.5 to 1.5%/year) through the application of functional genomic approaches.

To capture benefits from the technologies / products arising from the CRC research will require the development of agronomy and grazing management strategies that enable the expression of new traits, and feeding strategies that enable effective integration with supplements. That is management practices(s) will be needed to ensure most of the benefits gained at the research level are captured within farming systems.

Improvements in forage plant and grain characteristics are also likely to come through international breeding programs. Evaluation of new material from these programs under Australian conditions will be necessary to estimate the benefits in different environments. This R&D would fit well in Priority B (Section 6.2).

Strategic linkages with grain breeding programs through GRDC might deliver specific nutritive characteristics that provide benefits in increased nutrient supply or reduced negative associative effects between feeds. Such improvements could offer benefits for all farm feeding system types. However, it needs to be recognized that the major emphasis in grain breeding programs for wheat, barley and maize in Australia will remain focused on grain yield and characteristics that improve their suitability for

human uses. Changes in these characteristics may or may not have benefits for ruminant animals.

For dedicated feed grains, triticale and sorghum, grain yield will remain a primary goal, with some focus in sorghum breeding on improved nutritive characteristics for monogastric animals.

### Existing investment activities & key past investments

The Dairy Futures CRC is a major investment for industry and Government in pasture and animal-based biotechnology applications. It takes the most prospective opportunities from the last 7 to 10 years of investment and seeks to progress the core elements of each opportunity through to impact for the dairy industry. The outcomes from Program 1, 'Designer forages', (timeframes shown in section 5.1.4.) are:

- **Outcome 1:** A high level of utilisation of molecular breeding technologies in key temperate forages for the Australian dairy industry
  - Targets are perennial ryegrass, its endophytes and white clover
  - Incorporation of multiple molecular breeding technologies into existing breeding systems
  - Optimal design of breeding programs with molecular breeding technologies.
- **Outcome 2:** Applying molecular plant breeding technologies in new target species
  - Deploying validated molecular breeding technologies in new target species: namely tall fescue and its endophytes, C4 grasses, and lucerne.
- **Outcome 3:** Applying molecular plant breeding technologies for new traits
  - Creating value-added, high impact trait stacks
  - Trait dissection and technology development for new traits
  - Aligned with productivity, animal welfare, environmental and health and nutrition outcomes, such as bloat safety, methanogenesis mitigation, and infectious diseases.
- **Outcome 4:** Sustaining innovation in plant biosciences for the dairy industry
  - From candidate genes to whole genome selection
  - From transgenes to genome editing
  - Underpinning transition in global genetic supply industry: from seed through breeding to technology.

The CRC plant improvement program builds on a

number of recently completed projects listed in Attachment 3. The products and technologies will be delivered into CRC Program 3, 'Capturing the farm, factory and community benefits', which will address the complexity of introducing large innovations into modern dairy farming systems.

Recent projects in relation to grains for livestock provide a basis on which to plan future research in grain improvement for livestock production. They include: GRDC Premium grains for livestock program; GRDC Project JCS00002: Benefit to Australian Grain Growers in the Feed Grain Market; DA project UT13281: Improving the utilisation of red wheat by lactating dairy cows. Information on these projects is included in Attachment 3.

### Priorities for further investment, including outcomes sought

Four priorities have been identified for possible investment:

- **A1: Designer Forages: Plant improvement through the utilization of traditional and molecular plant breeding technologies.**
  - Plant improvement encompasses both forage plants (pastures & crops) and grains, and is being delivered through existing investments in the Dairy Futures CRC and GRDC. Targets include cultivar improvement, inclusion of new traits and novel endophytes, with priorities being driven by their potential value for farming systems.
- **A2: Improved access to novel international germplasm leading to use by Australian dairy farmers.**
  - The focus is about improved understanding and awareness of what germplasm is available and in the pipeline overseas and of the determinants of availability of such germplasm in Australia. The scope encompasses pastures, forage crops and grains. Uptake by the farm sector would be a subsequent step.
- **A3: Developing or accessing grains with nutritive characteristics to optimise nutrient use from grazed pastures or supplementary forages**
  - This is about understanding the 'ideal' characteristics of grains, particularly starch characteristics, for the five different feeding system types on dairy farms and estimating potential economic benefits at farm level. The 'ideal' characteristics may be sought from existing grains, including from overseas, through processing options, or through breeding options.

### ➤ **A4: Evaluation of the potential benefits of forage plant cultivar improvements within dairy systems.**

- This work may be part of CRC Program 3, 'Value capture'. It might include confirming the agronomy, grazing management and environmental conditions necessary for expression of traits as well as the interactions between new plant products and other components of the diet.

The outcomes for research priority area A are:

*Table 1. Outcome timeframe*

#### **Short (< 5 years)**

**A1: A high level of utilisation of molecular breeding technologies in key temperate forages for the Australian dairy industry**

**A2: Farmers more confidently managing their feedbase and its utilisation in changing circumstances through:**

- Improved access to relevant technologies.
- Increased awareness of forage & grain options available.
- Increased adoption of relevant technologies.

#### **Medium (5 – 10 years)**

**A1: Applying molecular plant breeding technologies in new target species.**

**A2: Scoping study & subsequent R&D: A '10%' improvement in energy capture/use by cows through better matching starch containing grains and silages with grazed pasture/forages.**

**A3: Farmers more confidently managing their feedbase and its utilisation in changing circumstances through quantification of improvements within whole farm systems taking account of intended and unintended consequences.**

#### **Long (> 10 years)**

**Outcomes from A1, A2, A3 & A4:**

- Improved access and adoption of pasture and forage plants with improved yield potential and better nutritive characteristics.
- Applying molecular plant breeding technologies for new traits.
- Sustaining innovation in plant biosciences for the dairy industry.

More detail on the R&D proposed (in addition to CRC program 1) can be found in Attachment 6.

### **6.1.5. Capabilities available and required**

In DMF (2009) an analysis was made of capability in the major R&D disciplines required in plant systems, namely plant improvement, crop and pasture production, agronomy and plant nutrition. The plant improvement R&D capability assessment in that report was:

**Table 2. Plant improvement R&D capability analysis taken from DMF (2009).**

	2009	1–5 yrs	5–20 yrs
Plant improvement	Adequate	Core →	Core →

The recent analysis of human resources in dairy RD&E (Peverill & Oates 2010) reported more than 60% of feedbase staff are younger than 40 years old, in comparison to only about 35% of all other RD&E staff being younger than 40 years old. “Newer” scientific disciplines, such as genomics, cell and molecular biology and GM crops and pastures, had the youngest age profile. The report indicated the discipline ‘improved plants / grains for dairy cow diets’ was apparently not well represented relative to demand.

The plant improvement and forage production workshop group (see Attachment 6) considered the capability and capacity in disciplines related to plant systems. In making their assessments, the group had access to summary material above and from the Peverill & Oates (2010) report, and used their experience in relation to capability needed to conduct the types of research recommended in the strategy.

It was considered that R&D capability in plant improvement was generally adequate as described in Table 2. However, retirement of applied breeders over the next 5 years could lead to inadequate capability in seed companies and it is becoming difficult for these companies to source this expertise from research agencies.

The group noted the Dairy Futures CRC is a critical ‘player’ in linking private and public agencies across the supply chain, that the CRC itself is sourcing some genetics inputs from the commercial sector, and it is a key in delivering new technologies to industry. There are specific individuals Nationally that are respected influencers across the public and private sectors and they are critical to keep the key commercial companies engaged.

### Route to market considerations

The Dairy Futures CRC program was developed in consultation with key players in the forage genetics supply industry. This ensures research discoveries/ products will be taken into the market through accepted processes. Evaluations prior to release usually involve assessments in line rows or at plot scale, but seldom involve testing in mixed swards, at field scale or in a whole of systems context. This applies to new cultivars produced from Australian research or those available internationally. Project concept A2 involves assessment of potential benefits of forage plant cultivar

improvements within dairy systems. Farmers will generally seek information on and try new cultivars when renovating pastures. Hence, systems evaluation, which is costly, is not an essential step in the adoption process, but it is critical to ensuring most of the potential benefits identified at the research coal face are captured on farms.

Potential exists to capture information from on-farm trials conducted by the commercial sector or service providers and to make this knowledge more widely available.

There are a few critical individuals that have reputation and respect that would need to be the ‘glue’ in each of these three whole of value chain projects

Project concept A1 refers to access and uptake of novel forage technologies produced overseas by the Australian Dairy Industry. This project is about understanding issues that affect the availability of material to Australian dairy farmers and, as such, is an examination of the route to market. It is essential that the project involve seed companies (pasture & grain); next and end users (private and public sector extension providers and farmers); and expertise in systems modelling, agricultural economics, market research, and sociology of adoption. Opportunities exist to conduct this project in partnership with other livestock industries/agencies (e.g. MLA). The degree of evaluation at field or whole of systems scale would be an issue outside the remit of this project.

The design of work proposed in A2 needs to involve a wide range of stakeholders from end users (farmers), next users (private and public sector service providers) to domain experts (plant breeders, agronomists, animal nutritionists, systems specialists, systems modelers, agricultural economists). A consensus on design and interpretation will be important to industry impact. The key challenge will be on designing studies to ascertain conditions for full expressions of novel traits and the subsequent fit into systems and associated risk management.

The third project concept, A3 ‘Variable / controlled starch release from grains’ is an examination of potential options and it also requires participation across the whole of value chain. Critical questions in pursuing breeding objectives specific to grain characteristics for livestock revolve around the benefits to grain growers and the grains industry. An analysis of the outputs of the recent GRDC ‘premium grains for livestock program’ is a prerequisite in designing this work.

## 6.2. (B) Filling agronomic and grazing management gaps for specific forages and combinations

### Statement of need

Traditional pasture systems in different dairy regions have underpinned the competitive advantage of Australian dairy farm businesses. Leading pasture-based farmers have fully exploited the current potential of these systems at farm scale and are now seeking alternatives to drive productivity improvements from their resource base. Recent climatic conditions and forecast increases in the variability of weather conditions have resulted in greater variation in the plant systems implemented on farms. Alternative systems involving greater diversity of forages in the farm landscape are seen as one way of combating declining terms of trade.

The activities in this priority area focus on specific forages including delivering key know-how on their agronomy (establishment/renovation, nutrient and water use) and grazing management that will optimise their production and in particular their 'fit' and role within systems. Low cost home grown feed production is and will remain important to all five feed system types. Improvements in the year round provision of high quality forages will have positive impacts on reduction in greenhouse gas emissions.

Farm system types 1, 2 and 3 are likely to differ in the types and diversity of forages produced with greater complexity for system types 2 and 3, particularly from the perspective of efficient utilisation. System type 4, which is a hybrid of grazed pasture and supplements during the growing season and TMR or conserved forage fed separately to concentrate during the rest of the year, encompasses a greater diversity of options. However, profit in these systems is clearly dependent on efficient use of available resources in home grown feed production and utilisation.

Feed lot systems require land for effluent disposal, and effective use of these resources, particularly for fresh cut and carry forage or conserved forages is integral to business performance.

### Rationale

Success of pasture-based systems is related to optimising (not maximising) home grown feed production and utilisation. Efficient use of land and water resources and livestock waste also makes this an imperative for zero grazing and hybrid systems of milk production. Optimising feedbase management also reduces off-farm impacts, such as nutrient loss.

There is a vast amount of knowledge for specific pasture systems and for some fodder crops on their agronomy (establishment/renovation, nutrient and water use) and grazing management for optimum production. However, while some farmers have fully exploited the current potential of these systems at farm scale, there are considerable opportunities for productivity gains on most dairy farms. This area of E requires careful thought and planning as there has been on-going investment for two decades, with less than expected change across the farm sector. There is a strong case for developing a better understanding of the factors constraining improvements in feed production and utilisation on farms, and if this is achieved for investment in targeted extension.

For leading farmers the 'fit' and role of different forages and combinations within systems is of key importance. The interest is in:

- › Management practices that ensure that home-grown forage (grazed or conserved) is 'delivered' to the animal with greater specificity (in terms of quantity, quality and timing) to optimise utilisation and conversion, in combination with supplements, into milk protein plus fat.

Other issues seen as important in the future are:

- › Understanding how to manipulate forage selection/preference by animals with the aim of better controlling intake of different feed components (nutritive value and other metabolites). This may include taking advantage of self-selection of the grazed diet by animals.
- › The application of precision grazing management technologies and methods to achieve measurable increases in feedbase production and FCE objectives.
- › A capacity to predict feedbase conditions (quality and quantity) in the future, from one week ahead to 9 months ahead, for improved tactical and strategic management decisions. This may include basic knowledge of the physiological response of forages to environmental and management changes, the use of better weather forecasting (although healthy scepticism exists about its ability to deliver accurate forecasts), or modelling.
- › How to optimise both production and resource objectives, particularly more efficient use of nutrients and water.

## Existing investment activities & key past investments

A great deal of RD&E has been conducted over the past decade in the feedbase production and utilisation area (see Attachment 3). Large integrated projects have successfully used combinations of simulation modelling, systems research and component research (within systems), as well as on-farm or partner farm initiatives to advance understanding in key areas of feedbase production, including defining the agronomic and grazing management principles for traditional and other pasture systems and of understanding the potential of complementary forage rotations. Examples of such projects include:

- UT 13190<sup>4</sup>: Beyond 20.12 Managing cool temperate pasture-based dairy systems for the future
- UM 13439: Project 3030 Phases I & II: Resilient dryland forage systems for increasing profit and managing variability.
- DAW12101: Greener Pastures (Phases I & II): Profitable and sustainable use of nitrogen in dairy grazing systems
- DAQ 12538: ForagePlu\$ 20.50
- US 11500: Future Dairy Phases 1 & 2
- DAV 13087: Flexible forage systems for variable water supplies

These have been significant investments and there is some opinions that while the R&D has been of high quality, this has not necessarily resulted in significant on-farm change. This is a key issue for investors who are looking for significant and rapid impact/change. An analysis of why time frames to change are usually so long may be warranted. For example, in relation to managing traditional perennial ryegrass systems, considerable investment in agronomic and grazing management extension commencing in the early 1990s, and continuing through extension programs such as 'Feeding Pastures For Profit' are still eliciting changes on farms. Similarly there is a great deal of research knowledge on requirements for P, K and S, but many farmers fertilize with higher than recommended rates of these nutrients (the safety net approach – ensuring no nutrient limitations).

## Priorities for further investment, including outcomes sought

Four priorities have been identified for possible investment:

- **B1: Foresighting to determine research questions for forage production that can deliver significant increases in farm productivity.**
  - This priority indicates there is uncertainty as to what research may give a significant step forward in feed production leading to farm productivity gains for farmers who have optimised their current feedbase systems. A counter point of view is that 'quantum' leaps in feed production at farm level are not realistic. While new technology contributes to ongoing productivity, the potential improvements measured in research are usually modified by the farming system and management resulting in lower than 'expected' growth in productivity. In other words, better decision making and technological advance need to work in concert. Two recent reports 'Grazing management principles for dairy pastures' (Final report to Dairy Australia on workshop; Attachment 3) and 'A target driven approach to increase forage production and utilisation in Southern Dairy Systems' (Project DAV11272; attachment 3) need to inform the design of this activity.
- **B2: Improved strategic, tactical and operational decisions in relation to how particular forages fit in the feed production and feeding system on farms.**
  - The focus is on a greater understanding of the seasonal production and nutritive characteristics of forages and how they can be better utilized in combination with imported supplements. This requires an increased understanding of plant x supplement x cow interactions for a range of forages within feeding system types. The activity overlaps with priorities C2 and D1
- **B3: Improved use of irrigation water to reduce seasonal feed deficits.**
  - This RD&E activity is about understanding irrigation water use x soil type x climate (year) x forage interactions, in order to make best use of rainfall and to make better forage choices in response to changing circumstances and opportunities. There is overlap with the 'Natural Resource Management' area.
- **B4: Maximising margins: minimizing foot prints — through improved whole farm nitrogen use efficiency.**

<sup>4</sup> Project codes refer to DA project numbers



- This priority encompasses setting targets, identifying areas for improvement and quantifying the economic and social impacts of N use efficiency in a whole farm context which fits largely within the ‘Natural Resource Management’ area. It also relates to improved feeding system efficiency through better capture of dietary nitrogen within the animal leading to improved energy utilisation for productive purposes which is encompassed in priority D1.

The outcomes for research priority area B are:

*Table 3. Outcome timeframe.*

<b>Short (&lt; 5 years)</b> <b>B1: Sound &amp; targeted research questions posed (6 to 12 months) that will lead to increased productivity beyond current knowledge in a changing environment—rainfall, irrigation, temperature, season length etc. The project outputs are short-term, but the opportunities identified most probably long term.</b>
<b>Medium (5–10 years)</b> <b>B2: Farmers and service providers making more informed decisions (strategic, tactical, operational) on forage choice within the system. Implicit are: forage planning, agronomy, plant x animal interactions, nutrition in a more variable environment.</b> <b>B3: Farmers making more informed decisions on feedbase options in response to changing circumstances (environment—rainfall, irrigation, temperature, season length etc) and opportunities.</b> <b>B4: Increased N use efficiency at the whole farm level, including improved efficiency in feed production and in the animal resulting in reduced N losses.</b>
<b>Long (&gt; 10 years)</b> <b>B2: Farmers and service providers making more informed decisions (strategic, tactical, operational) on new forage germplasm choices within the system. Implicit are: forage planning, agronomy, plant x animal interactions, nutrition.</b>

More detail on the R&D proposed can be found in Attachment 6.

## 6.2.5. Capabilities available and required

The analysis of R&D capability requirements for plant production, agronomy and plant nutrition from DMF (2009) are given in the Table below.

*Table 4. Plant systems R&D capability analysis taken from DMF (2009).*

	2009	1–5 yrs	5–20 yrs
Crop/pasture production	Adequate	Core ↑	Core →
Agronomy	Adequate	Core →	Core →
Plant nutrition	Adequate	Core →	Discretionary ↓

There is considerable R&D capability in plant production, agronomy and grazing management servicing the dairy industry. At the genetics and feedbase ‘experts’ workshop (Attachment 6) there was some difficulty in identifying important R needs (see concept B1) and a feeling there was a need to accelerate the use of existing information and technologies on farm.

The workshop participants made the following observations on R&D capability:

- **Agronomy & crop / pasture production:** It was indicated there was possibly a need to recruit to replace key personnel who have either left the country, moved to other roles, or there is uncertainty due to institutional funding. The group felt commercial companies were shedding agronomists, plant nutritionists and grazing management expertise, which will lead to gaps in the near future. In research, there will be a need for a focus on pasture and grazing ecology in evaluating new genetic material.
- **Plant nutrition:** It was considered capability was adequate as there was not much demand. The group also indicated that plant physiology skills would be useful in linking plant science and animal nutrition in feed characterisation.

## Route to market considerations

The agronomic principles and grazing management rules for traditional pasture systems are based on a body of high quality R&D and are well understood. Despite this, there is anecdotal evidence that adoption resulting in improved farm performance (e.g. increased pasture consumption/ha which is positively correlated with improved profit) has been less than expected. This is reflected in the identified need for Module 3 in DMF of ‘a focus on practice change to build capability for the future, with a particular emphasis on improved extension’. In this area (and others), there is a need to build capability in terms of understanding the domains in which the industry is trying to create the change—and to tease this out better than ever before. Understanding who the players

(seed companies, farmers, fertilizer people etc.) are; what positions they are taking and what value they see; and what true value proposition exists for accepting a new ryegrass or adopting a new management challenge are integral to understanding this issue. Of even more importance, is understanding the factors entering a farmer's decision making process that serve to make the apparent value proposition of change less attractive than industry perceives it to be (no debt; age; significant enough profit to fit family aims; workforce to be able to implement). An approach to address this has been developed by Brightling et al. (2010)

Examples of where adoption/change has been less than expected (given the knowledge base) include:

- Grazing management of traditional perennial ryegrass systems, where there has been considerable on-going investment in extension over two decades without significant changes in average pasture consumption per hectare within regions.
- Many farmers continue to apply excessive (based on research) amounts of N, P, K and S, despite advice to the contrary.

Understanding the reasons behind the slower than expected (change is happening) is critical to farmers and the industry capturing the benefits of R&D. For example:

- Lack of confidence in information / advice and/or how it is presented?
- Targeting the right audience (those wanting to change)?
- Better integration of home grown forage with supplements?
- Knowing where the system is now? What inputs might improve home grown pasture production and do the marginal returns exceed the additional costs when considered in a whole systems context?
- Have too many technology adoption leaders left the industry? If good farmers have left because they have decided they can return more on investments elsewhere, has this dissuaded others from improving their system?
- Are the risks of striving for improvements in the forage production system perceived as too high?

Considerable information, again from high quality R&D, also exists on the production/agronomy of crops that can be grown in different regions and integrated into dairy farming systems. Adoption and rate of change on farms is again unlikely to meet the expectations of investors. Understanding why some farmers have adopted and persisted, while others have tried and decided the technology didn't fit, will be important to capturing potential benefits from these more complex systems. Understanding and assessing risk for differing strategies will be important.

### 6.3. (C) More 'intelligent' characterisation of current and future dairy forages and supplements

#### Statement of need

Effective nutritional management of dairy cows requires knowledge of the energy yielding substrates and nutrients in feeds consumed. Basic descriptions of the nutritive characteristics of feeds [dry matter content, estimated metabolisable energy (ME) content, and concentrations of crude protein (CP), neutral detergent fibre (NDF) and acid detergent fibre (ADF)] are a reasonable starting point. In grazing systems, difficulties exist in knowing the nutritive characteristics of consumed pasture (in comparison to those of pasture on offer) on farms, an issue that applies to the use of both traditional and more sophisticated feed descriptions.

The traditional analyses listed above are useful in understanding the relative value of concentrate or conserved forages, particularly when such feeds are purchased. However, only 25 % of farmers use these analyses when purchasing fodder, and 36% when purchasing grain / concentrates (Dairy Australia National Dairy Farmer Survey, 2010). Even fewer farmers analyze home grown forages routinely. The barriers to adoption by farmers include: cost (i.e. perceived value for money); turnaround time; convenience; ability to interpret results; and confidence in the results.

While these basic analyses are useful, the complexity of today's feeding systems and the drive for efficiencies in producing milk from a range of possible feed combinations, predicates the need for more sophisticated descriptions of dietary ingredients. More detailed descriptions of specific chemical and physical characteristics of feeds allows better analysis of how they interact with the animal. For example, the fermentation pathways of different carbohydrates (water soluble carbohydrates, starches, structural carbohydrates), which are primary energy yielding substrates, differ resulting in different rates of production and different proportions of volatile fatty acids produced and absorbed. This in turn has consequences in tissue metabolism, including milk protein and fat synthesis.

Characterizing the structural and non-structural carbohydrate fractions, and the nitrogen containing compounds in terms of rate and extent of digestion has been important in improving the feeding system efficiency in feed lots. While pasture-based systems have unique challenges, the complexity of diets being used suggests more complete characterisation of feeds will be important to efficiency improvements.

## Rationale

Improved application/use of the existing basic descriptions of the nutritive characteristics of feeds can lead to improved feeding system performance on many dairy farms. This relates not only to the purchase of supplementary feeds, but also to the use of laboratory analysis or existing data bases of the basic feed characteristics in making operational and tactical feeding decisions.

Despite projects like the AFIA ring test (see below), laboratories are using different methodologies and calculations to derive estimated values for ME.

The specific focus of improved characterisation is:

- › Understanding the interactions between dietary ingredients in terms of total feeding value as influenced by intake, associative effects between feeds, and effects on rumen function.
- › Informing how different home-grown forages should be produced and delivered to the animal.
- › The application of more sophisticated knowledge of the nutritive characteristics of feeds in practice will require:
  - A capacity, including tools/technologies, to measure and monitor the more detailed characteristics, possibly in 'real-time'.
  - An ability to forward predict feed characteristics across all feedbase components.
  - Linkages to nutritional models and other decision support systems.

More sophisticated characterisation of all feed sources (home-grown and brought-in) is applicable across the five feed system types and across environments.

## Existing investment activities & key past investments

Recent and current key investments relating to the use of routine / basic descriptions of feed nutritive characteristics include:

- › **GRDC:** Premium grains for livestock program: which produced an extensive database of the chemical and physical characteristics of grains, NIR calibrations for energy values, and a process for the rational trading of grains for livestock.
- › **AWTA 13272:** Coordination of AFIA ring tests for feed testing laboratories: the overall objective is to improve the accuracy of feed test analyses by laboratories in Australia and New Zealand.
- › **GWT 13413:** NIR in dairy factories: rapid feed analysis project: piloting an alternative model for delivery of feed analyses services to dairy farmers.
- › **GGF 12930:** Managing the risks associated with grain/concentrate and fodder purchasing: developed an information pack for dairy farmers on alternative quality, supply and price risk management strategies for grain/concentrate and fodder purchasing, including practical guidelines on how to engage in contracts with grain farmers or traders. More sophisticated analyses of feeds has become routine practice in research, where samples are sent to laboratories that provide a breakdown of the carbohydrate composition of feeds as well as other important characteristics. Recent and current projects specific to better characterisation of feeds include:
  - › **GRDC:** Premium grains for livestock program: produced a comprehensive database on chemical, physical and morphological characteristics of cereal grains that can be linked to animal performance measurements.
  - › **BRA 12433:** Effect of feeding grain on ruminal acidosis in cattle: validation of an NIR acidosis index: aimed to develop an index to reflect risk of acidosis created by feeding different amounts and types of grain to dairy cattle.
  - › **SA 13264:** South east forage innovation stage three (SEFI 3): aims to examine the nitrogen containing compound in perennial ryegrass, validate maize starch characterization in relation to perennial ryegrass and other feeds in rations, and develop a decision support model enabling farmers to optimise feedbase scenarios in irrigated forage systems.

## Priorities for further investment, including outcomes sought

There is strong agreement amongst nutrition researchers and advisers that the industry standard should move from the traditional analyses to an agreed set of more comprehensive analyses (see Attachment 6 for list of types of analyses). This would need to be supported by the means/ability to interpret the more complete feed description data. This is important as intensification has led to a diversity of feeding systems that cannot be represented by simplistic nutrition models. To exploit the full potential of many systems requires a greater understanding of dairy cow nutrition (see Priority D; Section 6.4) and responses in production to different feeding strategies. Against this background two priorities for RD&E have been identified.

- › **C1: Increased understanding and on-farm use of 'traditional' nutritional parameters that characterize feeds.**
  - This priority is largely D&E and is about overcoming barriers to use of feed assessment (physical, visual) and basic feed analysis (NIR predicted and/or wet

chemistry analysis) leading to improved decisions on dietary ingredients and their suitability in different production systems.

- **C2: Application of more 'sophisticated' characterisation of feeds to improve efficiency of conversion of nutrients to milk protein + fat.**
  - RD&E in this priority is longer term, but essential to capturing potential productivity gains from complex feeding systems. It includes defining and agreeing the key 'sophisticated' nutritional measures in the context of different feeding systems, developing a national database of Australian feeds based on these characteristics and expanding the use of more sophisticated nutritional software beyond expert users to a wider group of nutritionists.

Based on the activities in the two priorities proposed, the outcomes for research priority area C are:

Table 5. Outcome timeframe

#### Short (< 5 years)

C1: More farmers accessing traditional feed evaluation & advisory services.

C2: The minimum standard for feed analyses in the dairy industry is a 'Dairy One' type analysis, testing for different carbohydrate components not just estimated ME.

C1: Generalist and new nutrition advisors providing improved advice on traditional feed evaluation & on ration formulation leading to measured improvements in conversion of feeds to milk protein + fat.

#### Medium (5–10 years)

C2: Wider adoption of more 'intelligent' characterisation of feeds, with use by an increased number of competent dairy nutritionists and laboratories.

C2: Assessment of the applicability of physically effective fibre in pasture-based systems.

C2: Nutrition advisors providing improved advice on managing feeding systems and diet formulation leading to measured improvements in conversion of feeds to milk protein + fat.

#### Long (> 10 years)

C2: More 'intelligent' characterisation of feeds has been accepted as the industry standard and is in general use by most dairy nutritionists.

C1 & C2: On-farm productivity gains in feeding systems from measured improvements in conversion of feeds to milk protein + fat.

Overall outcome: *'Farmers confidently managing their feedbase resources to optimize profit and to enable them to adjust their systems in response to changing circumstances and opportunities'*

More detail on the RD&E proposed can be found in Attachment 6.

## Capabilities available and required

The capabilities required to capture benefits from both projects included extension specialists (considered in section 6.3.6), ruminant nutrition (research and practical/applied), ruminant biochemistry/physiology, systems modelling and feed chemistry. The animal science disciplines required are considered in Section 6.4.

Feed chemistry skills are seen as discretionary and can be sourced from capability servicing other industries.

Modelling skills in terms of development of animal models exist in several agencies (e.g. DPIV) and can be sourced through international collaborations, while model user skills are quite strong amongst existing research capability and experienced nutrition practitioners.

## Route to market considerations

As described above, there are a number of existing projects aimed at improving the use of traditional feed analyses and the barriers to wider adoption have been identified. The recent and on-going projects are targeting turnaround time, convenience and the variation between laboratories. The proposed project needs to overcome the barriers to adoption in perceived value and ability to interpret the results. A number of nutrition training and extension activities are in place, and project C1 needs to be developed with input from those involved, including the NCDEA, and to complement/improve these activities. It also needs to involve farmers (key influencers) who routinely use these feed descriptions and who can articulate the benefits to their business. To achieve the desired changes, engagement of all the key players in this area of development or research/extension will be needed.

Given the time taken to get adoption of traditional descriptions of feed characteristics, it can be expected the time frame to increased adoption of more sophisticated descriptions (project C2) may be longer than expected. The target 'end users' are farmers with more complex feeding systems (those feeding high amounts of grain in the type 2 system, and those with system types 3, 4 and 5). Experience and understanding are needed in the interpretation of more sophisticated analyses and in the use of nutrition models. This suggests the 'next users', in the first instance, will be nutrition advisers and scientists. There are time costs to advisers in gaining experience with complex nutrition models and with the on-going use of such tools. It also should be recognized that all of the available models have limitations when used in grazing systems. However, there is experience in their application to such systems and in training programs, for example those run by

SBS cibus and Agri-Science QLD, for advisers and farmers. This experience should enable appropriate targeting of extension activities and an opportunity to assess adoption.

#### **6.4. (D) Understanding and optimising intake and managing associative effects between feeds**

##### **Statement of need**

The need for research in this priority area is justified by the conflicting beliefs amongst scientists and nutrition advisers as to the nutritional principles that apply in grazing systems, particularly the systems using higher amounts of supplements. This has left dairy farmers generally confused in relation to what they should believe.

This priority drives specifically at how to improve the efficiency with which feed is converted to milk across all dairy farm systems. This challenge is complex, particularly in systems where grazed pasture or forage is a significant component of the diet, and, hence in practice, is usually in separate meals to supplementary feeds.

It is not physiologically possible for grazing cows to achieve the same potential intake of those fed well formulated and presented mixed rations in zero grazing systems. The primary constraints to intake relate to limitations in the number of bites a grazing animal needs in prehension and processing fresh pasture and the volume of feed that needs to be processed. While some nutritionists believe intake is constrained by rumen fill and can be predicted from the NDF content of the diet (a principle that applies to mixed ration diets) there is no research evidence that this is the case in grazing animals. In fact measurements of the diurnal variation in rumen digesta loads, associated with grazing behaviour, indicate this may not be a constraint to intake. Further, the management practices applied by farmers limit pasture intake by the allowances they allocate. This area is an example of where the principles developed in pen feeding systems should not be assumed to apply in grazing systems.

Opportunities exist to understand the interactions between pastures, forages, concentrate supplements and co-products through research into the matching of feeds in both the amount and way in which they are fed. Implicit in this is a better understanding of plant-animal interactions and nutrient selection. It is theoretically possible to increase the efficiency of use of nitrogen from pastures through appropriate provision and timing of starch supplements to improve microbial protein

production, a benefit that would also spare energy expenditure in excretion of excess urea from tissues with consequent increases in milk production. This is one example of positive associative effects between feeds.

In applying energy requirements and supply systems to milk production by dairy cows, it is also important to have a better understanding of negative associative effects between feeds. For example, it is known that when the rumen pH falls below 6.0 due to ingestion of high digestibility pastures, cows are predisposed to sub-clinical acidosis when fermentable starch is fed. The impact is reduced availability of energy from pastures and conserved forages. While this is known to occur, the magnitude of such effects in grazing systems, and their implications for milk protein + fat production are poorly quantified and understood.

Improvements in the efficiency with which feed is converted to milk protein + fat across the five feed system types also has implications for greenhouse gas emissions (methane and nitrous oxide) and nitrogen use efficiency at the animal and farm level.

##### **Rationale**

There are immediate gains to be made in feeding system efficiency on many farms through improvements in pasture allocation and in minimizing dry matter and nutrient losses from supplements during storage and feeding. However, the savings from improvements in these areas need to be of benefit at the whole system scale.

An understanding of the underpinning principles that determine intake in grazing compared with feed lot systems would assist many farmers in making better decisions on the use of supplements. However, while there is a general reluctance to using existing technologies to measure or estimate intake (even with the inherent inaccuracies) it is difficult to visualize how feed intake can be optimized. Estimates of FCE enable some evaluation of the performance of the feeding system used on farms, and provide the ability to diagnose where improvements might be made. In addition, the potential annual and/or seasonal FCE in system type 1 is much lower than in system types 4 and 5. Hence, the targets that farmers might aspire to should be realistic and it is not economically sensible to try to maximize FCE in any system type.

Understanding how positive associative effects between feeds can be captured and negative associative effects can be limited is integral to improving feeding system efficiency. Issues include:



- › What are the impacts of different combinations of grains with different rates of fermentation and rumen retention times for high vs low producing herds/cows in different systems?
- › What are the interactions between different feed combinations and stages of lactation?
- › What are the effects of different fibre sources on rumen retention times?

A common element to all of these questions is how to optimise rumen function in relation to ruminal starch and fibre digestion and microbial protein production.

Clearly it is not possible to conduct experiments to answer the many complex questions that exist in relation to nutritional management of dairy cows (particularly in system types 1, 2, 3 and 4). This means a combination of research and modelling will be required, but it needs to be understood that most existing models are based on pen feeding research, not on systems where the diurnal variations in presentation of substrates to the rumen are critical determinants of efficiency of nutrient use.

Real/significant advances will only be made if the investment is in research that defines the underpinning principles for responses in milk protein and fat production, partitioning of nutrients to body tissue, feed conversion efficiency and voluntary feed intake with changes in feeding practices. Most recent R&D had focused more at an input (feeds) and output (milk) level, which has led to a diversity of views/opinions in relation to why, when and what magnitude of responses might occur when diet is altered.

For TMR systems, the information from proposed project C2 (Section 6.3) will provide benefits in being better able to utilise international research, which provides many of the principles underpinning such feeding systems.

### Existing investment activities & key past investments

As indicated above, most recent R&D in cow nutrition has focused more at an input and output level, which has led to a diversity of views/opinions in relation to why, when and what magnitude of responses might occur when diet is altered.

There has been considerable research examining milk production responses to low to moderate amounts of grain supplements fed in the dairy (see Attachment 3; System type 1 and some in system type 2). This has provided knowledge on the key factors influencing substitution of supplements for pasture (in traditional pasture systems) and marginal milk production responses to increasing amounts of supplements. A key criticism of this research has been the short term nature of the experiments. However, an analysis commissioned by

DA, 'Meta-analysis of longer term feeding trials' (see Attachment 3), indicates the findings and principles elucidated in the short term experiments apply in relation to longer term milk production responses. Examples of projects that have contributed to a greater understanding of milk production responses to low to moderate amounts of concentrate supplements fed in the dairy are:

- › **DAV 403:** Grazing ecology – interactions between supplements, dairy cows and pastures.
- › **DAV 427:** Increased marginal responses and milk solids in cows grazing high digestibility pastures through supplementation.

The implications of feeding high amounts of concentrate supplements in system type 2 are less well researched, and considerable controversy exists. The majority of farmers in most regions of Australia categorize themselves as being in this system type. There have been a number of systems projects that have examined milk production in systems where significant amounts of concentrates have been fed. Examples are:

- › **DAV 12955:** Feed2Milk case studies.
- › **DAQ10785:** Sustainable dairy farm systems for profit.
- › **DAW046:** Vasse milk farmlets: productivity, profitability & sustainability of intensive dryland dairying systems in the Mediterranean climate zone of Australia.

There have also been investigations of the effects of nutrition on milk composition in projects such as:

- › **DAQ11602:** On-farm management of milk composition to enhance the competitiveness and profitability of the Australian dairy industry.
- › **DAV10757:** Variation in milk composition on farms due to nutrition, management and genetics.

As indicated previously most of these studies have examined responses to feeding strategies without elucidating the underlying mechanisms.

While an increasing percentage of farmers have started to move to system type 3, there are very few published papers on feeding mixed rations to complement grazing. None of these have examined response relationships between the amount of mixed ration fed and pasture intake or milk protein + fat production. Hence, DPIV and DA have invested in the 'Flexible feeding systems project – Ellinbank' (see Attachment 3) which has the objectives of:

- › Defining the conditions under which high-energy concentrates are best used, and to develop systems to efficiently and effectively use partial TMR's
- › Develop flexible and efficient feeding systems and strategies that optimise cow performance, health and welfare.

It is considered that R&D should focus on system types 2 and 3, based on their prevalence and because it will also provide information relevant to system type 4. As indicated above, international research provides principles and understanding that can be applied to TMR (type 5) systems, providing the local feeds are described in sufficient detail.

An issue that is common across feeding system types is appropriate management of cows through the dry period and into early lactation (the transition period). A recent project, **DAV 10678: Production and reproduction in dairy cows – interactions between body condition and nutritional management**, and a review of the key principles/influences on health, fertility and production of the cow through management of the transition period (by Ian Lean and Peter DeGaris) provide a solid basis for planning future RD&E on this topic.

### Priorities for further investment, including outcomes sought

In the feed characterisation and nutrition workshop, the following priorities were identified and discussed in relation to different system types:

#### System types 1 & 2

- Optimising N use in systems using herbage containing >25% CP – this is 50% of the year in high N systems, but also occurs in lower N input systems.
- Interactions between protein and carbohydrates, including understanding starch degradation rates and the implications for protein supply and glucose supply in spring / early lactation. Also expand further on the protein:energy principle to investigate the relationship between protein:starch/sugar, particularly in high protein pasture-based diets.
- Prevalence and impact of pasture derived mycotoxins.
- Increased requirements for digestible, rumen undegraded protein on high grain diets.
- Designing transition diets to improve milk production, cow health and reproduction.

#### System types 3 & 4

- Site & extent of degradation of starch and protein.
- Nutrient digestion and the role of glucose turnover in the small intestine on satiety.
- Management of conserved feeds (forages and co-products) – storage (spoilage & losses) and feed out (losses).
- Designing transition diets to improve milk production, cow health and reproduction.
- Improved nutrient requirement targets – e.g. is 22–25% starch in the high producing cow appropriate.

- Improved synchrony between grazed pasture and PMR feeding.
  - Nutrient specifications of PMR in terms of starch, sugars, metabolisable protein, NDF to complement grazed pasture.
  - Optimum pasture intake through feeding management when PMRs are fed.
  - Integration of alternative forages into feeding systems.
- Based on this list, three priorities were identified.

- **D1:** More efficient utilisation of N and carbohydrate from feed sources for optimised FCE and milk protein + fat production.
  - The focus is on R&D into better understanding the nutritive characteristics of feeds and how they can be fed in combination to improve conversion of nutrients into milk protein + fat, and reduce the incidence of sub-clinical acidosis. R in this area needs to be informed by and to inform the further development of nutritional models. There will be Natural Resource Management outcomes in reduced nitrous oxide emissions and methane per unit of milk protein + fat.
- **D2:** Improved transition cow diets and management pre and post calving for higher production and improved cow health and reproduction.
  - The focus is on D&E to increase awareness and adoption of key principles/influences on health, fertility and production of the cow through management of the transition period and on RD&E to evaluate milk production and reproduction benefits (independent of disease reduction) from better pre- and post calving nutrition. An output would be best practice management procedures with a sound understanding of the importance of each dietary component. There is overlap with the 'Animals' area.
- **D3:** Reduced quality / quantity losses during storage, mixing and feed-out of fodder, co-products and mixed rations.
  - This priority would explore opportunities to improve feed storage methods, to extend the shelf-life of co-products and to reduce wastage in feed out systems that can significantly reduce DM losses and declines in nutritive value of feeds. An output would be resources / tools to support farmers in decisions on storage and utilisation of supplementary feeds.

The outcomes from this priority area are seen as:

Table 6. Outcome timeframe

<b>Short (&lt; 5 years)</b>
D3: Improved storage and feed out management of conserved forages and co-products leading to reduced wastage and feed costs, improved feed intake and FCE.
<b>Medium (5–10 years)</b>
D1: Improved prediction of responses to supplementary nutrients across feed system types.
D1: Opportunities for the production of milk with improved functionality for processing
D1 & D2: Reduced metabolic disease incidence leading to animal welfare benefits, reduced costs of production and consistent milk quality and composition.
D3: Improved formulation and presentation of mixed rations leading to increased intake and optimized FCE measured through higher productivity per cow and per hectare.
<b>Long (&gt; 10 years)</b>
D1 & D2: Productivity gains through optimized FCE, resulting from an understanding of the principles underpinning responses to supplementary feeds across a range of feeding systems and diets, resulting in increased profit.
D1: Environmental benefits through improved N utilisation and reduced N excretion, reduced methane per unit of milk protein + fat.
D2: Animal health benefits through reduced incidence and severity of metabolic disease and improved reproductive performance leading to less involuntary culling.

More detail on the RD&E proposed can be found in Attachment 6.

### Capabilities available and required

The feed characteristics and nutrition workshop considered capability in disciplines related to animal systems.

Table 7. Animal systems R&D capability analysis taken from DMF (2009).

	2009	1–5 yrs	5–20 yrs
Breeding & genetics	Inadequate	Core ↑	Core →
Nutrition	Inadequate	Core ↑	Core →
Reproduction	Inadequate	Core ↑	Core ↓
Milk harvesting	Inadequate	Core →	Discretionary ↓
Vet Med	Inadequate	Core →	Core →
Growth & development	Adequate	Discretionary ↓	Discretionary →

The consensus view across this group was:

- Breeding & genetics—now had adequate R&D capability/capacity.
- Nutrition—there is a requirement for some increased R&D capability, probably by recruitment in northern Australia and through post graduate students and postdoctoral fellows in southern Australia. In terms of rumen microbiology potential exists to strengthen capability through collaborations with scientist working in the beef/sheep industries or through international collaborations.
- Reproduction—considered inadequate; possibilities exist to source expertise working in other industries.
- Milk harvesting—considered the assessment above was reasonable.
- Veterinary medicine—considered adequate R&D capability on an industry wide basis. It was pointed out that while this might be so, veterinarians servicing the industry will become concentrated in a few large, dairy cattle-focused vet practices, and farmers in many dairying areas will not be well serviced.
- Growth & Development—considered the assessment above was reasonable.

Modelling skills in terms of development of animal models exist in some agencies (e.g. DPIV) and can be sourced through international collaborations, while model user skills are quite strong amongst existing research capability and experienced nutrition practitioners.

### Route to market considerations

Improving farmer and service provider knowledge in dairy cow nutrition is a challenging area, but education capability development is a pre-requisite to feeding system efficiency gains. Feed intake and digestion in grazing dairy cows are complex and there are dangers in trying to synthesize this complexity into simple messages. The diversity of feeding systems means that advice needs to be tailored to particular circumstances and it is not always possible to apply principles derived from pen feeding studies to grazing dairy cows.

Currently deep knowledge of dairy cow nutrition resides with a few people, and they often have different views on the principles that apply in grazing systems and requirements for particular nutrients. An example of this is requirements for rumen un-degraded protein in grazing cows fed high amounts of supplements. The reality is it is difficult to resolve such differences when there is a dearth of data on protein degradation in the rumen and flows of rumen un-degraded protein to the intestines in grazing cows.

This indicates the importance of soundly designed R that targets areas of conjecture and elucidates principles/mechanisms behind responses to changes in diet or feeding. Prior to the 'Flexible feeding systems project – Ellinbank' there were only three papers in the international literature concerned with feeding mixed ration supplements to grazing cows. None of the studies involved graded amounts of supplement to examine responses in milk protein + fat production or the implications for pasture intake and utilisation.

Most current extension programs are focused on basic grazing principles and rudimentary approaches to nutrition. While this works quite well for type 1 systems, it leads to issues with effective use of supplements in type 2 and 3 systems. As an example, while there are seasonal variations in the availability and nutritive characteristics of pasture and cow requirements vary with stage of lactation, many farmers flat rate feed concentrates throughout lactation.

While route to market considerations are complex, delaying critical research in this area will continue to foster confusion, with potential adverse impacts on farmer decisions and dairy farm business performance.

To achieve the changes desired in relation to improved feed utilisation (cow nutrition) will require asking the right questions in R&D and having the correct information about how the market actually works when building up these programs. Engagement of all the key players in this area of RD&E, in particular those involved in education (Universities and the NCDEA), public and private sector service providers, those in the market (feed companies and veterinary practices) and key end users will be essential. Base research information, once it is established as being sound, needs to be fed into the Curriculum of the NCDEA to 'embed' it or codify it within the industry.

## 6.5 (E) Development and deployment of 'precision' dairy farming technologies

### Statement of need

Understanding and measurement is integral to effective management decisions – 'if you don't understand it and can't measure it, you can't manage it well'. In dairy farming, timely, accurate and objective measurement of all resources, from soil and water to feed, animals and milk production and composition, added to sound understanding, would allow for more accurate, timely and efficient management of those resources. Optimising the conversion of feed to milk (FCE) is based firstly on knowing (and measuring) a systems current FCE, and then understanding where improvements can be made.

Increased water productivity and nutrient use efficiency would benefit from accurate and timely understanding of plant available water and nutrient loads, respectively. Inherent in capturing the value of this capability to measure/monitor is an irrefutable need to interpret the measurements and be able to adjust accordingly.

Some aspects of the farm system, such as milk production and gross composition, are already routinely measured, but use of such information often doesn't extend to individual cow management and often the data is not fully interrogated to benefit. Sound economic decisions on feed production (and on feeding) rely on estimates of the value of the marginal return from extra production in relation to the marginal costs. Pasture parameters, such as pasture production and pasture intake, fundamentals for diet formulation are not routinely measured even when tools and techniques are available. The amount of supplements delivered in the dairy often differs from what the farmer believes is being delivered. Wastage occurs in relation to pasture utilisation and in supplementary feeding systems (the difference between what is offered and what is consumed), but it is inherently difficult to measure. If appropriate measurements are not part of routine farm management then marginal analysis is at best a guess. This logic possibly explains the major reasons for excessive use of fertiliser by many farmers and the debates about responses in milk protein and fat production to extra supplement.

'Precision dairying' is a commonly used, but often poorly defined objective. Technologies for precision farming allow for rapid and/or 'real-time' monitoring of all resources on a farm (soil, water, plant, animal, milk) to enable better and more timely management (operational, tactical and strategic) of those resources. In some instances this lends itself to automation of routine procedures. Increased profitability is usually the key desired outcome for precision technologies, but other outcomes are improved Natural Resource Management impacts (e.g. soil and water management), social (e.g. labour efficiencies and lifestyle) benefits, and animal health and welfare benefits.

Technology growth is often cited as a key driver of total factor productivity.

### Rationale

The over-riding rationale for this priority is that measurement and evaluation of marginal responses is integral to productivity gains (more profitable dairying). Any capacity to quantify or measure using technologies must offer greater accuracy and/or timeliness, and in order to be of value must be able to be interpreted and used within the farming system.



The core components to this priority area are:

- Identification of the components of the farming systems that, if they were able to be measured and interpreted using technologies, would offer the most potential benefit to a farm business. Based on that value proposition, consideration of the technological solutions that could be applied to that issue.
- Consideration of how technologies interact with people, and usually require data interpretation (including modeling), systems integration, and support in order to capture value.

Specific opportunities include:

- Measuring pasture production (biomass, utilisation and nutritive characteristics) for improved operational, tactical and strategic pasture allocation, renovation, more efficient input of water and nutrients resulting in increased pasture and animal productivity.
- Measuring daily pasture consumption to assist pasture and animal management, ration formulation, and calculation of FCE.
- Monitoring the rumen for key parameters (e.g. pH, retention time) to maintain an optimal rumen environment for FCE and animal health.
- Quantitative measurement of land management units across the farm to enable management (tactical and strategic) to be tailored more specifically.
- Monitoring soil, water and forages for more efficient use of inputs (water, nutrients) leading to sustainable improvements in production per unit of land.

- Integrating data flows into models and decision support systems to create both 'real-time' and predictive knowledge to aid farmer decisions.

There is a range of Development and Extension opportunities for existing technologies that have not seen extensive adoption on farm. This warrants an understanding of the constraints to adoption (technological as well as social), to not only aid value capture for those opportunities, but to inform how new technologies are best developed and supported.

The commercial implications of developing new technologies, and the likely need for systems integration and ongoing support, will necessitate close ties with the private sector. Public investment may be better placed in understanding the value proposition of technological solutions, systems fit, and how to support adoption and value capture in industry.

### Existing investment activities & key past investments

Objective measurement of pasture has been identified as a key opportunity to increase pasture consumption. This has included:

- Satellite remote sensing (UM12970 'Pastures from Space'; see Attachment 3) which established a technical accuracy similar to rising plate meters. More recently the on-farm 'usability' of the technology as a data delivery mechanism was evaluated; and provided insight into what sort of 'technological package' will be required for different farmers to make satellite delivery a potential commercial product.





- Bike-mounted technologies have been evaluated in a range of projects (e.g. **US 10957: Development of a more relevant forage base for the dairy industry in warm temperate regions of Australia**, **US13009 Future Dairy**, **DAV12955 Feed2Milk Case study farms**) all evaluating the technical accuracy of the technology.

These technologies are at various stages of development in New Zealand and overseas, offering opportunities to leverage off investment elsewhere.

Rumen probes for measuring key rumen parameters, such as pH, have been evaluated (e.g. **US13009 Future Dairy**), but as yet have not been found to be reliable and robust in a commercial farm setting.

Irrigation technologies, including soil moisture monitoring have been embedded in projects such as **UT13190 Beyond 2012**, and the economics of sub-surface drip irrigation evaluated in **DAV12624 Modelling Dairy Farming Systems**.

Animal tracking, quantifying and monitoring animal behavior, and virtual animal control has been extensively developed in other cattle industries by CSIRO.

There are a diverse range of investments in private industry and other RDCs that would have direct potential applicability to the Dairy Industry.

The Future Dairy team (University of Sydney) are exploring different ways to improve estimates of dry matter intake by combining modelling with more detailed information of the cow (daily milk production, automatic LW, potentially auto BCS, etc).

### Priorities for further investment, including outcomes sought

No project concepts have been developed at either of the 'experts' workshops due to insufficient time.

However it was clear that key systems parameters that need near real-time measurement are (1) pasture biomass and pasture and total feed intake. These are critical drivers for improved pasture allocation, pasture production and animal productivity (via optimizing FCE); (2) measuring rumen function (including retention rates, pH) remains of interest for optimizing FCE and animal health.

The integration of real-time data flows with predictive simulations is seen as important for informed decision making and risk management.

Three priority areas are suggested to determine how better to invest in this area, to identify next generation technologies of interest, and to understand how to capture

the value of new and existing technologies on farm:

- **E1. Foresighting to determine priority technological solutions across different farm systems**
  - This priority indicates there is uncertainty as to which technological solutions offer the greatest potential for benefit across different farm systems, and what is required to bring those technologies to market. For any given application on farm, there may be different technologies that can be utilised, each potentially at different stages of conceptualization or commercialization. This priority is focused on looking across next generation technologies and their potential fit and value in farming systems.
- **E2. Understanding how to broker effective partnerships within the commercial sector in order to provide on-going support for technologies on-farm.**
  - The commercial implications of developing new technologies, and the likely need for systems integration and ongoing support, will necessitate close ties with the private sector.
- **E3. Market research to understand views of farmers and service providers on the potential use of technology within their farm system, and drivers of adoption to enable industry to capture value from existing and future technologies.**
  - There is a range of Development and Extension opportunities for existing technologies that have not seen extensive adoption on farm. An understanding of the constraints to adoption (technological as well as social), would not only aid value capture for those opportunities, but also inform how new technologies are best developed and supported.

The outcomes for research priority area E are:

*Table 8. Outcome timeframe*

#### Short (< 5 years)

**E1: Identification, prioritization and investment in next generation technologies with greatest potential value for industry**

**E2: Effective partnerships across the public and private sectors established that enable enhanced support for the capturing of value for new technologies on farm.**

**E3: Improved route to market strategies for existing technologies to enable on farm capture of industry value.**

**Medium (5–10 years)**

E1, E2, E3: Development and implementation of new and existing technologies supported from conception through to adaptation on farm to capture their full value in industry.

**Long (> 10 years)**

E1, E2, E3: More effective tactical and strategic management decisions through timely, accurate and objective measurement of farm resources.

**Capabilities available and required**

Capabilities required in technological innovation are broadly available across many livestock and potentially human, computing, manufacturing industries. The major plant and animal science capabilities, and particularly farming systems expertise, required in testing technologies in research or on-farm are available to the industry. Market research could be conducted by social research groups in the University of Melbourne and/or DPIV, or by engaging commercial providers. There are no foreseeable capability gaps, particularly when effective partnerships can be developed with the private sector and other industries.

**Route to market considerations**

The immediate need in this area is understanding route to market considerations and impediments to effective use of existing technologies that have been deployed on farms. Development / design of market research projects in this area requires not only social science expertise, but inputs from farmers with an interest or who have used/ purchased technologies, service providers and discipline scientists working in the field to which the technology applies.

**6.6 (F) Whole systems modelling to increase understanding and predictability of farming complexity****Statement of need**

Understanding the impacts of feedbase and feed utilisation changes within complex farm systems is integral to effective RD&E and to achieving the strategy outcome. Modelling is a key underpinning approach critical to evaluating the impact of innovations in a systems context, not only from a biophysical perspective, but also in terms of business performance and social aspects. It also provides a capacity to identify gaps in knowledge and to help prioritize R&D.

Robust biophysical modelling, the complexity of which will depend on the question being addressed, integrated with social, economic and risk analyses, is required to understand innovations across all farm system types and

in different environments. Incorporation of risk analysis, in relation to prices and costs, the ability of different farmers to capture the benefits of technology (management skills) and climate variation, is essential in such modelling.

**Rationale**

Examples of R&D approaches to farm systems analysis include the use of simulation models, built to examine components of the system or whole farms, or case study approaches integrated with purpose built spreadsheets for the biophysical and economic aspects of the system. The question being addressed best determines the choice of approach. It is important to recognize that models and modelling approaches to evaluating innovations need to be improved as knowledge advances and approaches to assessing risk in agriculture improve. It is also important to note that the value or quality of the outputs is dependant on the expertise of the project team and their ability to integrate knowledge from a range of sources. Such sources might include farmers, public and private sector advisers, published research, science discipline experts, and those involved in policy.

Industry input suggests DairyMod, APSIM and the Sustainable Milk Production models will remain important in evaluating innovations. These will require integration, ongoing improvements to incorporate new functionality (and validation), upgrades, and maintenance. This new functionality will include more sophisticated nutrition capability.

Strategic improvements in modelling capacity are likely to include:

- Use of case study approaches across a wider range of farming systems and regions.
- Integration of models (eg DairyMod/APSIM) to enable examination of all forage types in a farming system.
- Functionality similar to GrassGro for more flexible and meaningful predictive scenarios.
- A capacity to better forward predict both the quantity and quality of all the feedbase components, as well as the operating environment.
- Improved weather/climate forecasting, although healthy scepticism remains around whether this will eventuate.
- Dairy cow models with improved intake predictions in grazing systems and in predicting digestion patterns within the rumen.
- The integration of data collected on or readily available to farmers into decision support systems and modelling in real-time.
- An agreed national approach to evaluating risk.

## Existing investment activities & key past investments

There has been considerable investment in the development, validation and deployment of DairyMod, which has been used in developing many of the recent farming systems RD&E projects. A current project is consulting key end-users to prioritise what model improvements are required.

A collaboration between Australia and New Zealand (**UM 12127: Whole farm systems analysis and tools for the Australian and New Zealand grazing industries (WFSAT)**) has been integrating models relevant to the grazing industries into an integrated framework. The objectives of Phase 2 were: to use the model and base 'credible' simulations developed to address questions of strategic industry and investor relevance; develop further capability with general model users and develop an advanced users group using the WFSAT Models and Tools; and to complete and road-test the integration of the Models into the CSIRO's CMP. Current projects, e.g. **US 11500: Future Dairy 2** have been designed to contribute to the Australian/NZ investment into the co-development of the whole farm systems tools (WFST).

Within **DAQ10785: Sustainable dairy farm systems for profit**, physical models of future farming systems, which provide an interactive learning environment for farmers and advisers, were developed and these now form the basis of Dairy Predict within the Sustainable Milk Production (SMP) tool. The SMP tool has been used to examine farm options in the lower Murray Darling Basin during the recent DA inquiry into dairying in the lower basin.

There are current and recent projects which have involved development or evaluation of animal models.

The **GRDC Premium grains for livestock program**: developed a simulation model (named here the Nagorcka model) of cattle for feedlot systems. This model operates on time steps that enable simulation of the diurnal pattern of rumen fermentation in relation to the pattern of feed intake. A current investment, **FARM 12270: Support to John McNamara during his sabbatical in Australia**, is evaluating the use of the Molly metabolic model and it's potential successor model, 'the Nagorcka model', in research programs in dairy nutritional research, primarily on pasture based and mixed-feeding management systems.

At an applied level, project **BRA 12879: Evaluation of applied dairy nutrition programs in Australia**, has examined the strengths and weaknesses of applied nutrition models that are being used by the Australian dairy industry to assist in feeding management decisions. Specifically, the project explored the extent to which a model can be applied in practice to assist tactical decision making and the ability of a model to: a) accurately predict the milk yield and composition responses to pasture and supplemental grains/ concentrates under different circumstances; b) estimate marginal milk yield response to supplemental grains/ concentrates; and c) account for any errors in input values, such as nutrient composition of feeds, animal and environmental factors.

In addition to work with or on specific models, there has been a program of work in Victoria that has used



case studies, purpose built spreadsheet models and an 'expert panel' to examine issues confronting the industry. The current project is **DAV13037: Dairy Directions – analysing farm systems for the future**. The approach has been used to examine the impacts of drought and recovery strategies on different irrigated farm types and the impacts of changing water availability, price and policy of farm viability. The team has developed an approach to analysing risk associated with milk prices and key input costs using @Risk from Palisade. The current activities include analysis of the impact on business performance and risk of: Climate variability and climate change, including irrigation water price and availability, and availability of home-grown feed; Milk and feed price fluctuations and rising input costs, such as fertiliser; Labour productivity investments; and Policy changes (e.g. an emissions trading scheme). The program has been used to build R&D capacity in farm systems analysis and to assist key industry service providers, industry support professionals, and farmers to think in a complex farm systems context.

Across many projects, modelling tools are integral in refining in situ research, and understanding whole-of-system impacts. In focus and partner farm initiatives (e.g. 3030, Beyond 2012), DairyMod, Udder and business analysis, such as Redsky, have been integrated to analyse the farm business and explore the potential impact of making different changes to that system.

### Priorities for further investment, including outcomes sought

The priorities for this area will be developed in collaboration with the 'Farm Business Systems' area, and will need to ensure integration with the 'Feedbase and Animal Nutrition', 'Animals', 'Natural Resource Management' and 'People' themes. The capability to deliver on this area should largely come from the 'Farm Business Systems' area {Strategy 1}, and the tools for economic and risk analysis should be developed/maintained through the 'Farm Business Systems' area {Strategy 2}.

Specific to this feedbase area, an immediate need is to review the existing capability in biophysical modeling and agree on:

- Priority improvements in the underpinning science
- New or improved functionality (including improved response functions and risk assessment)
- Integration with other modeling capability, particularly other forage types (eg APSIM), nutrition models, and business management models
- Application/accuracy across different farming system types and regions
- Approaches to integrating knowledge from relevant areas
- Succession planning strategies in relation to R&D.

### Capabilities available and required

In relation to farm business systems capability the group in the plant improvement and forage production workshop considered the description in the table below reflected dairy industry needs. Key issues in growing or developing capability were seen as high turnover —loss rates of young staff and difficulty recruiting experienced staff. They stressed the need for scientists in dairy farming systems and integrated whole and partial systems modelling to interact with consultants in the development and use of models.

Those developing the Farm Business Systems strategy indicated the data in the Peverill and Oates report and the Table below doesn't tell a great deal about the level of skills/expertise. They also indicated the number of tertiary institutions that provide relevant training in these areas have declined markedly in Australia. Hence, it will be difficult to recruit graduates with training in these areas in the future and the data doesn't identify this potential issue.

*Table 9: Farm business systems R&D capability analysis taken from DMF (2009).*

	2009	1–5 yrs	5–20 yrs
Dairy farming systems	Inadequate	Core ↑	Core →
Integrated systems modelling	Inadequate	Core ↑	Core →
Farm & land management & agribusiness	Inadequate	Core ↑	Core →
Agricultural economics	Inadequate	Core ↑	Core →
Business & financial management	Inadequate	Core ↑	Core →
Development of systems support systems	Inadequate	Core ↑	Core →



## Route to market considerations

This priority area is linked closely with 'Farm Business Systems'. The research in this strategy should be designed with a view to testing the assumptions, response functions and limitations of existing tools or models of feed production or cow nutrition. Biological response functions are characterised by diminishing returns and it is important models of components of the farm system adequately reflect this principle. There is a valuable opportunity to use models to inform the design of research and to further develop both simple and complex models if the research is designed to provide appropriate information.

To evaluate the impact of R&D on farm profit and risk, it is important research findings and biological models are linked to economic models working on a time scale appropriate to the question being addressed. Modelling and models can assist in providing a better understanding of the complexity and interactions of the systems dairy farmers are managing. However, it is important to involve key stakeholders, particularly farmers and experienced farm management consultants, in formulating the key questions to be asked and in evaluating the assumptions used in analysis.

There is a need to consider how the benefits of modelling can be incorporated into the business proposition of key service providers. For example, existing programs modelling farming systems need to establish how they can make a contribution to capability development and understanding of systems thinking.

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## Attachments

These attachments are included as a separate volume.

Attachment 1: Dairy Moving Forward R & D priorities for Feedbase / Animal Nutrition. [Developing the skills and knowledge that allow us to retain and manage an internationally competitive feedbase] Principle Author: Dr David Henry, March 2010.

Attachment 2: Industry Discussions, Strategies & Other Documents Examined.

Attachment 3: Current & Recently Completed R&D Projects.

Attachment 4: Previous Priority Setting Exercises in Relation to Supplementary Feeding & Feed Systems RD&E.

Attachment 5: Ken Peverill and Hugh Oates (2010) A Dairy Moving Forward Summary Report for Updating the Human Resource Capability and Infrastructure Data for Dairy RD & E in Australia.

Attachment 6: Reports on 'experts' workshops.



# DAIRY MOVING FORWARD



## ANIMAL PERFORMANCE RD&E STRATEGY



## Acknowledgements

**This National Strategy for Dairy R,D&E in ‘Animal Performance’ has been developed as an activity of Dairy Moving Forward—a dairy industry initiative to develop a strategy and capability plan to guide pre-farmgate R,D&E. It has involved extensive stakeholder consultation with representatives from the dairy industry, government, and the providers and funders of dairy R,D&E.**

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## 1. Executive Summary

The primary objective of the animal performance R,D&E priorities is **“Dairy farmers’ confidently managing animal performance to deliver farm profit, health and welfare outcomes.”**

To enable farmers to achieve this outcome four areas of investment are outlined that the participants believe will successfully develop the skills and knowledge to drive current and future dairy herd performance. To achieve the desired industry outcome four strategic priorities have been proposed (Figure 1).

While the four priority areas for animal performance are presented separately below, they are clearly not independent and a strong focus has been maintained on the whole farm system, while exploring the possibilities within any single strategy.

### Priority 1. Breeding herds that perform in Australian conditions

Priority 1 identifies the key elements of industry capability that are required for the Australian farmer to achieve his or her herd breeding objective, and for the Australian industry to realise the national breeding objective. To achieve these goals it is necessary for farmers to be able to choose sires that meet their breeding objective need, and then be able to successfully get their cows in calf.

While genetic improvement has continued to make a major contribution to farm productivity the gains have fallen short of the potential benefits because of a fragmented industry structure and because the genetic strategies have not been integrated with the other elements of the production system.

This strategy priority aims to identify the key elements of industry capability that are required for the Australian industry to effectively manage herd fertility and to realise

the big advances in genetic improvement.

In order to meet the objective of breeding herds that perform in Australian conditions focus must be provided to all areas outlined in the:

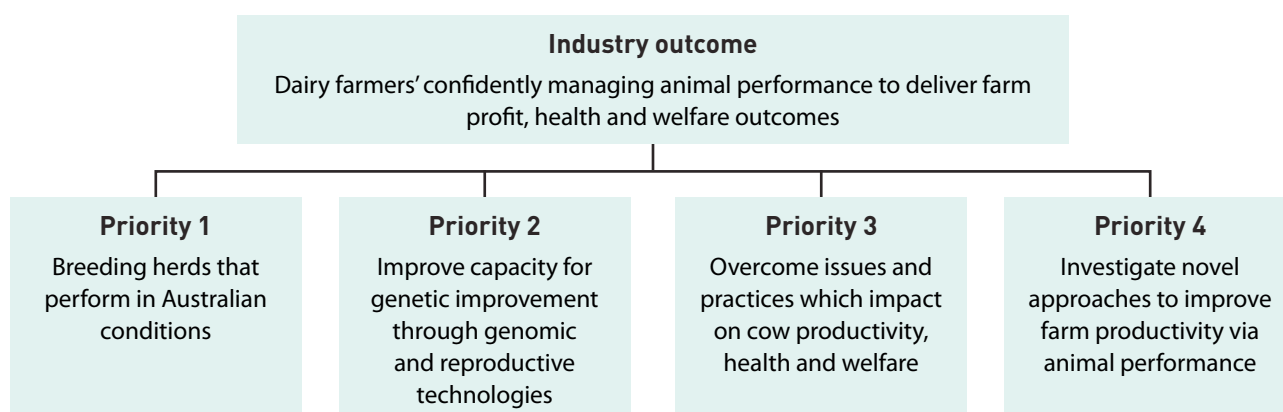
1. **Genetic Gain**—Increasing the genetic merit of the national herd for profit and ease of management
2. **Fertility**—Ability to manage cows and get them in calf soon after their mating start date
3. **Industry data to support on-going R,D&E**—Improving the amount of good quality industry data and research data to answer key questions about animal system limitations and enable better genetic selection.
4. **Extension and Education Services**—Ensuring R&D activities are uniformly and effectively extended throughout the industry to assist improvements in Genetic Selection, Fertility and Culling decisions.

### Priority 2. Improve capacity for genetic improvement through genomic and reproductive technologies

Substantial improvements in the genetic selection of cattle can be achieved with genomic and reproductive technologies. This will drive productivity growth and facilitate the current market demands to be able to breed according to a diverse range of breeding objectives

Genomic technology is essential for the sustainability of Australian Breeding Values (ABV), i.e. the domestic capacity to measure genetic merit. It is a positive technology, where it can double the rate of genetic progress and also deliver reliable breeding values that meet individual farmers’ breeding objectives. It is also a critical technology, where the counterfactual case of not having a domestic genomic technology would

Figure 1. Desired outcome for Dairy Moving Forward – Animal Performance R,D&E strategic priorities.



quickly handicap the ABV system against the import of genomic technology.

The ability to favour female calves through the use of sex-selected semen has numerous benefits. First, it increases genetic progress through the ability to be selective of which heifers to rear. Second, fewer male dairy calves reduces the requirement for rearing and marketing bobby calves. Third, it offers greater flexibility to farmers based on expected markets for different progeny. Some years it might be worthwhile to maximise the number of dairy replacements for domestic use or for export, while other years it might be worthwhile to also breed some dairy-beef calves for sale into the beef market.

### Priority 3. Overcome issues & practices which impact on cow productivity, health, and welfare

The essential elements of managing animals for optimal health and well being are considered in three sub-programs:

1. Cattle Management
2. Animal Health
3. Milk Quality/Milk Harvesting.

The Cattle Management sub-program is largely concerned with optimising the interaction of animals and humans in the built environment on dairy farms. Particular emphasis is placed on the control of heat stress, calf rearing, and prevention measures to avoid animal lameness.

Animal Health considers the preparedness of the dairy industry to prevent and respond to animal disease outbreaks in order to minimise the biosecurity risk and optimise the welfare of animal across the dairy industry.

The milk quality and milk harvesting chapter in this report provides broad guidance for the dairy industry in the area of milk quality and milk harvesting over a 5-year horizon with particular emphasis on the control of mastitis.

### Priority 4. Investigate novel approaches to improve farm productivity via animal performance

Priority 4 addresses capability requirements to maximise the potential benefits (and minimise the potential frustration) for Australian farmers who choose to invest in automatic milking and/or new sensing technologies. These include:

- › Improve the efficiency and sustainability of labour by eliminating unnecessary tasks and reducing drudgery
- › Monitor individual cow production, weight and body condition

- › Detect disease early and accurately to minimise impacts on milk yield and milk quality
- › Automate detection of physiological status of animals (eg, pregnancy, oestrus, anoestrus)
- › Alert farmers to the nutritional status of cows through rumen sensing devices
- › Provide supporting industry IT infrastructure.

### Interdependency with other Dairy Moving Forward programs

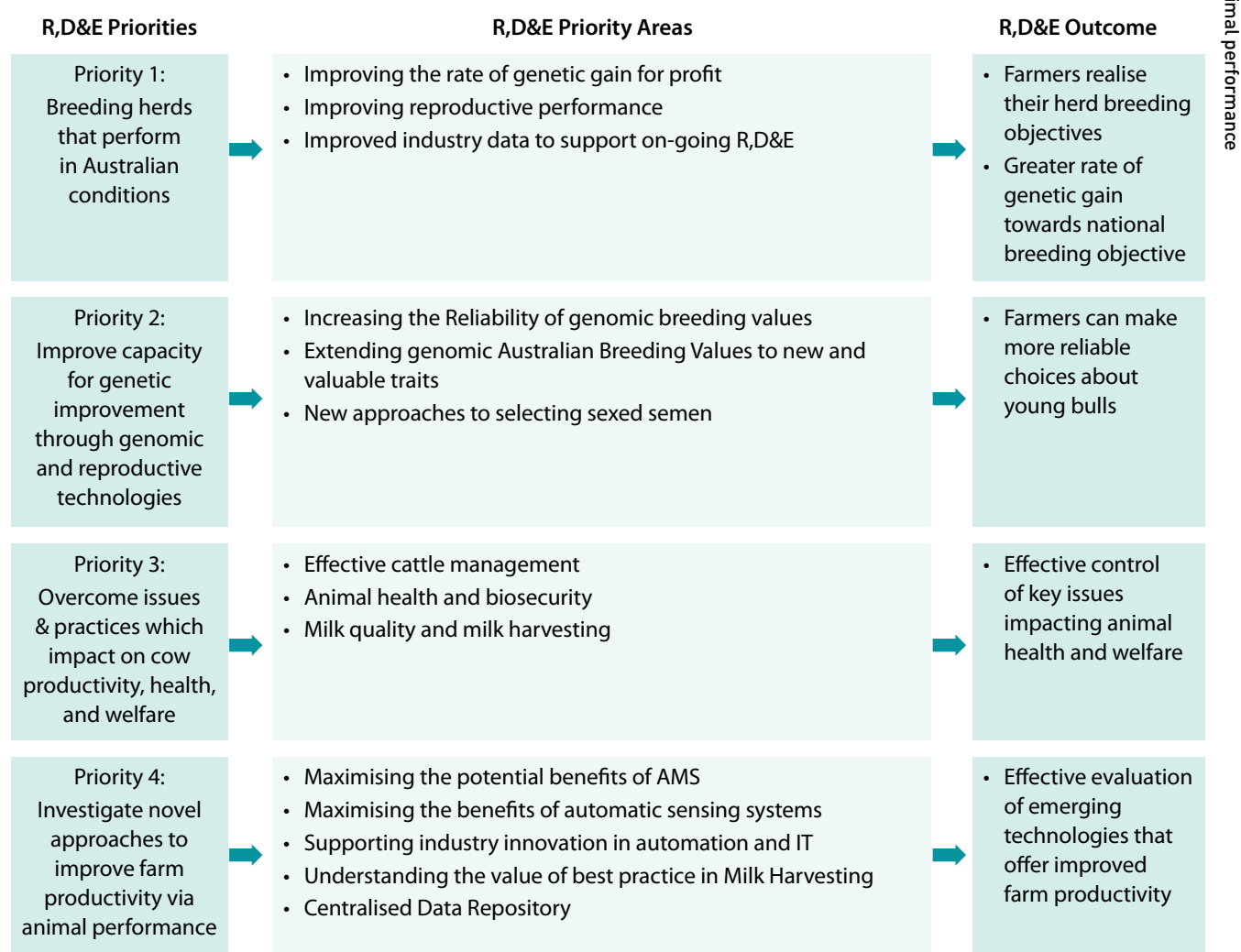
The Animal Performance R,D&E priorities outlined in this report are interdependent on R,D&E priorities in other Dairy Moving Forward programs. For example:

- › Availability of capable people and a supportive culture on farm are key assumptions in achieving the Animal Performance outcomes. Issues such as fertility, mastitis and animal husbandry often have a human component that must be included in animal management plans
- › Many of the decisions farmers will make about animal management systems will rely on sound understanding of Farm Business Systems, access to the tools necessary to make informed decisions, and a culture on farm that supports the use of available tools
- › Feedbase and Animal Nutrition—Transition feeding, animal nutrition and the implications of feeding systems on animal husbandry and animal welfare are examples of interactions between Feedbase and Animal Nutrition that underpin achievement of Animal Performance outcomes
- › Natural Resource Management and Climate Change—Research into feed conversion efficiency will have implications for the emissions associated with animals as will many of the decisions farmers make about the management of animals on farm. Adaptation to extremes in weather is an important consideration in the management of animal husbandry on farm
- › In addition sustainability reporting initiatives such as the Global Reporting Initiative are putting pressure on the dairy industry to be able to demonstrate good animal welfare management practices are in place at farm and industry levels.

The Animal Performance R,D&E priorities must be thought of as targeting one aspect of the total farm system. They cannot be separated from the other areas of R,D&E without undermining the assumptions made during the development of the recommendations contained within this report.



Figure 2. Priority areas and industry outcomes for Dairy Moving Forward—Animal Performance R,D&E priorities



## 2. Context for the development of the animal performance strategy

Improvements in Total Factor Productivity across the dairy industry have been modest across the past 20 years with estimated rates of improvement oscillating (most recently downwards) between 0–2% per year. Improvements in animal productivity primarily driven through escalating genetic capacity (Australian Selection Index) have contributed up to one-third of those gains<sup>1</sup>. Genetic gain is significant, embedded in our system input (cows) and cumulative in impact. Currently there is a curious juxtaposition where there are clear potential barriers to the continuity of this historic level of performance (funding, education, data capture and integration, software, hardware, personnel) at the same time at which the technical opportunity (molecular breeding values; marker assisted selection) is nearly unparalleled in breeding history.

Having sufficient control of breeding performance in order to optimise farm profitability and cow health and longevity is an issue. The interaction between emerging or changing farming systems and the reproductive performance of the herd within them invites investigation.

Developing highly profitable and sustainable animals which cater for our unique Australian dairy systems and the emerging challenges (e.g. GHG emissions, declining reproductive performance and increasing herd size) presents itself as a clear priority. There is a need for an integrated strategy that identifies the processes, funds and expertise to ensure that cow performance is not the weak link in future production systems.

<sup>1</sup> Australian Dairy Herd Improvement Scheme figures (unpublished)



### 3. Strategic Priority Area 1: Breeding herds that perform in Australian conditions

#### 3.1 Overview

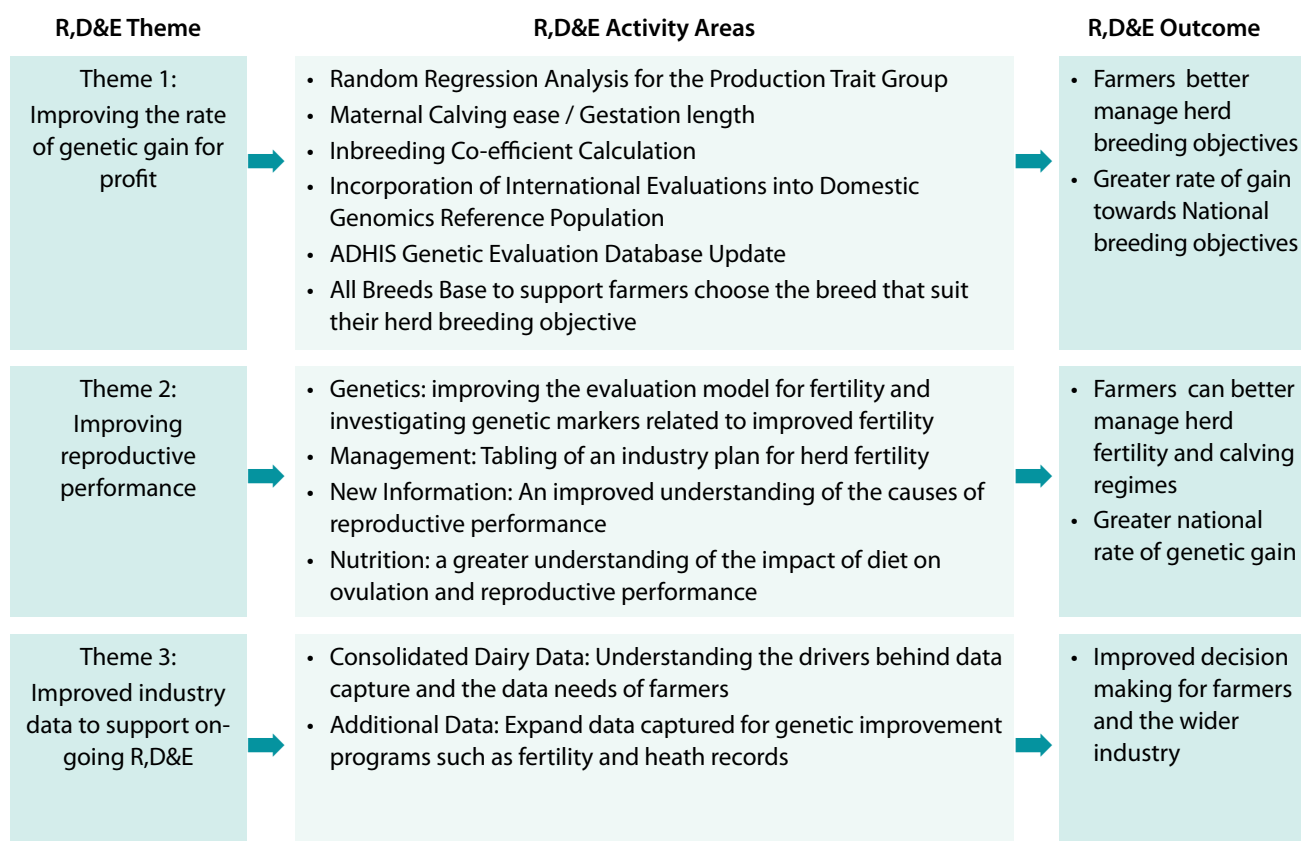
Strategic Priority 1 identifies the key elements of industry capability that are required for the Australian dairy farmer to achieve his or her herd breeding objective, for managers to optimise herd reproductive performance and for the Australian dairy industry to breed cows suitable for Australian conditions. To achieve these goals it is necessary for farmers to be able to choose sires that meet their breeding objective need, and then be able to successfully get their cows in calf soon after mating start date. This priority area addresses the key steps in the genetic supply chain that is outlined in Appendix 1 (Figure 13) <sup>2</sup>

#### Desired industry outcome

While genetic improvement has continued to make a major contribution to farm productivity the gains have fallen short of the potential benefits because of a fragmented industry structure and because the genetic strategies have not been integrated with the other elements of the production system.

This strategy priority aims to identify the key elements of industry capability that are required for the Australian industry to effectively manage herd fertility and to realise the big advances in genetic improvement.

Figure 3. Strategic Priority Area 1 R,D&E themes and industry outcomes.



<sup>2</sup> *Please note – information contained in this report has been taken (sometimes directly) from a range of stakeholders and reports which are either new thinking, previously presented to industry (including the 2005 DA/DPI R&D Plan for Dairy Cattle Genetic Improvement) or in the process of being development. Authors of this information not in the expert list noted above include Dr Pauline Brightling and Prof Mike Goddard. Many issues noted and identified are necessarily new but a still relevant to the area of breeding high performing dairy herds. An attempt has also been made to align desired R,D & E with current activities and plans being carried out by key stakeholders in this area*

In order to meet the objective of breeding herds that perform in Australian conditions focus must be provided to each of the following areas:

➤ **Genetic Gain**

- Increasing the genetic merit of the national herd for profit and ease of management

➤ **Fertility**

- Ability to manage cows and to get them in calf soon after their mating start date

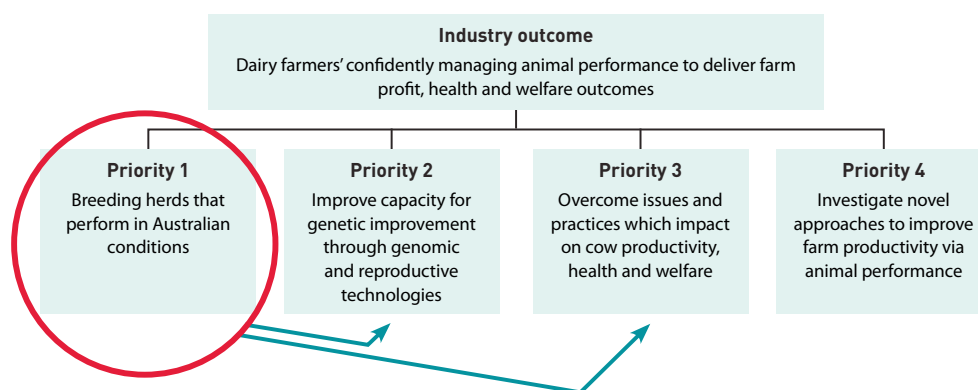
➤ **Industry data to support on-going R,D&E**

- Improving the amount of good quality industry data and research data to answer key questions about animal system limitations and enable better genetic selection.

➤ **Extension and Education Services**

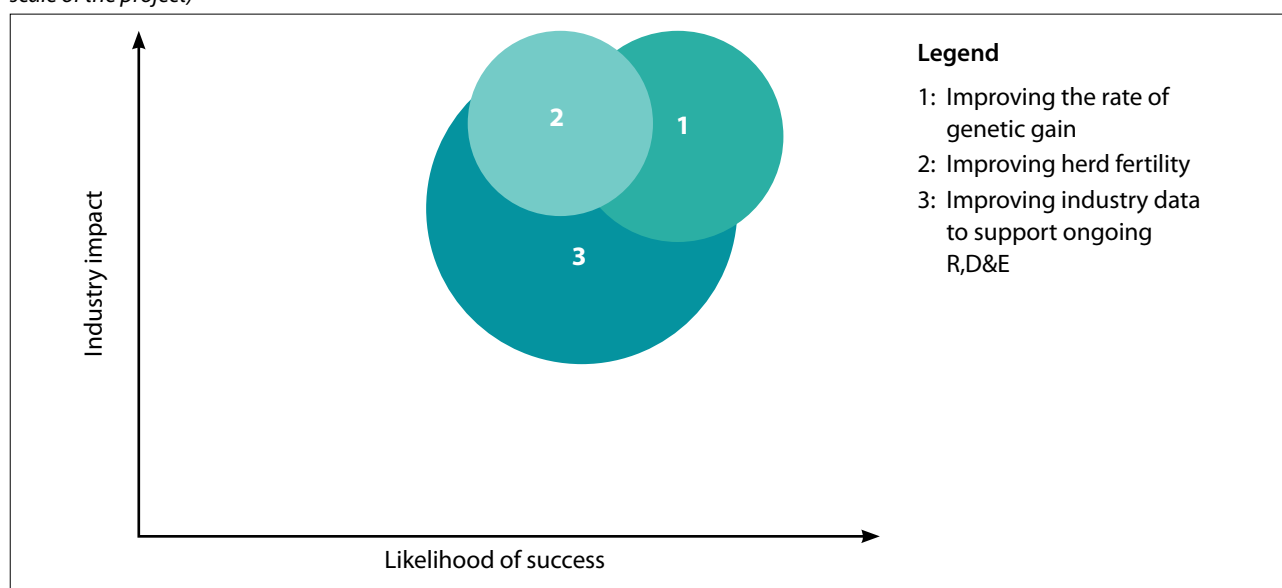
- Ensuring R&D activities are uniformly and effectively extended throughout the industry to assist improvements in Genetic Selection, Fertility and Culling decisions.

The illustration below based on Figure 1 outlines the framework to achieve this outcome and how *Strategy 1* fits within this model. It should be noted that we see synergies and cross over in the various strategies as indicated below.







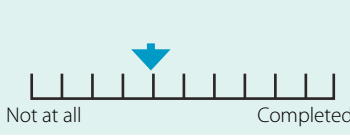
## Impact vs Success

Figure 4. Ranking investment priorities in Priority Area 1 – Industry impact versus likelihood of success (size of the bubble indicates scale of the project)\*



\* Estimations of impact, likelihood and scale of project are qualitative only and reflect the opinion of the Dairy Moving Forward expert working group

## Capabilities available and required

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		Relevant organisations exist improvements in collaboration possible
Do these people and organisations represent the majority of prior learning in this area?		The majority of learning exists in these organisations however the use/ addition of nutritionists or animal physiology experts would assist
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		Benefits from investment are clear as is the case that market failure in these areas also exists
Would the collaborators be able to provide diverse avenues for change?		Current avenues well developed but new avenues would need to be explored to maximise benefits from investments
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		Looking at the priority areas. Funding, infrastructure and people are limiting factors here. Would also require strong industry leadership to drive and support initiatives

## 3.2 Existing investment activities & key past investments

### Genetic Gain

The Australian Dairy Herd Improvement Scheme (ADHIS) has conducted national genetic improvement since 1982. During this time a range of traits has been added to assist farmers in making selection decisions. There are a range of documents and reports outlining the past activities of ADHIS and this report does not seek to go over these items however, the following lists key recent activities which include:

- Commencement of a genetics extension and education program
- Updates to the expression of non-production ABVs
- Update to the national breeding objective (the Australia Profit Ranking – APR)
- Development and release of Selectabull
- Providing farmer 'Selectabull' training courses in association with DEC
- Development and release of the Good Bulls Guide
- Incorporation of genomics (DNA) data into national genetic evaluation including the development of a database to support this system.

These activities have come about with the support of Dairy Australia and its predecessors who provide significant funding to ADHIS. With the advent of genomic technology and the significant time/ investment spent in its implementation a range of key R&D activities remain unfunded. These are noted in the Priority Area 2.

### Fertility

The reproductive performance of dairy cattle is an area of interest across a number of industry bodies. Currently ADHIS focuses on the genetic contribution to fertility whilst InCalf is the industry program focused primarily on the other management aspects of fertility. Consideration must be given to ensuring consistency of messages between genetics and management.

#### *Fertility Management*

InCalf is the lead agency for the dairy industry in relation to the management aspects of fertility. This project was based on the results of a large research project which identified key factors that influence fertility and potential areas for improvement. This data is sometimes now viewed as 'dated' given changes in genetics, nutritional management, herd sizes, calving systems and per cow milk yields and an improved picture of the current status of fertility (performance and determinants) is desirable.

There is an undercurrent of issues around fertility that have come to a head during the discussions for Dairy Moving Forward in mid-2010. Observations from the field are that fertility is decreasing – that there is not quality data at a national level to confirm, refute or explore this and that ‘other’ reasons for poor reproductive performance need to be explored.

This provides a substrate for uneasiness: a growing belief that the problem is attributable to “Holstein-isation” of the Australian dairy herd; concerns that high producing herds are innately more likely to have fertility problems; advocacy by some key players to increase herd fertility through crossbreeding (a change in farm system for many) and increased enquiry about the profitability of split calving versus seasonal calving systems (incorporating extended lactations).

With this in mind, the InCalf project has decided to fast-track an industry fertility needs assessment now.

Past InCalf activities have revolved around:

- Farmer Action Groups (FAG). A training program for farmers that ran over a year. In most cases for real and sustainable action to occur on farm, farmers needed to be actively involved with a qualified adviser at the end of the program.
- Adviser training courses (ATC). 300 advisers have been accredited through the ATC, however only a relatively small number are actively using InCalf in an advisory capacity.

Research from the “Achieving Sustainable Improvement” project revealed that there are many challenges in incorporating advisor capability into action.

Current strategies have centred on developing advisory activity to encourage and assist farmers to make changes to lift their reproductive performance.

## Current Strategies

### Adviser Engagement Strategy

- Recognising that advisers are the key to facilitating change to occur on farm, strategic direction was altered and the Adviser Engagement Strategy was initiated. Each InCalf module was redesigned to:
  - Provide content that suits those businesses actively involved in client interactions in each topic area
  - Achieve the greatest possible reach by making practical and simple to adopt, condensing sometimes complex options into ‘rules of thumb’
  - Suggest ways for service providers to open conversations around these topics
  - Encourage farmers to assess their herd’s situation.
- Good interactions with clients around the various aspects of herd fertility can:
  - Provide farmers with focused, timely advice
  - Facilitate risk management strategies
  - Reinforce best practice messages
  - Give clear, well founded advice in response to enquiries.

**The InCalf modules.** Good management is needed on several fronts to get cows in calf as soon as possible after mating starts:

- Bull management (Bulls: Power Up!)
- Heifer growth (Heifers: Big Girls XL)
- Heat detection (Cows in Colour)
- Artificial insemination (AI Do It Right)
- Cow health and transition management.

### Development of “Cow health and transition feeding” module

- This is a collaborative effort between Grains2Milk and InCalf
- A technical review has been written on “Feeding and management of the transition cow” (to calving) as a reference for highly qualified nutrition advisers (co-authors Drs Ian Lean and Peter Degaris)
- An Adviser handbook, which will appeal to the broader advisory community, is currently being written
- Practical tips and the benefits of transition feeding will be available for farmers
- Delivery of resources and extension messages to advisers and farmers will occur between the two projects.

### **“The InCalf Pack”**

- › When the ‘Cow health and transition management’ module is complete a ‘Pack’ of all the materials from the Adviser Engagement Strategy for farmers will be created to bring a set of practical farmer technical materials together in one place. In doing so, it will raise the profile and awareness of the fertility messages delivered through InCalf, reach a wider farmer audience and enable the project to get another run from its investment to date.
- › New content will be added to make the pack a well rounded stand-alone resource. This includes an InCalf perspective on genetics (links to the Good Bulls Guide and Selectabull), crossbreeding and extended lactation. Information will also be provided on how to get a Fertility Focus report and how to use it to assess reproductive performance
- › Distribution to farmers will be arranged with particular emphasis on exploring opportunities for joint activities with the Dairy Australia communication network, RDPs, DPIV etc.

### **The InCalf activities in 2010–11 are:**

- › To develop an industry plan for fertility: a clear, consistent and authoritative position on herd fertility for the industry and a process for going forward. This body of work provides the opportunity for energetic and interested parties to engage and starts a process of realignment. The timing for the InCalf Review has been brought forward.
- › To increase the profile of InCalf messages and get stakeholders, dairy farmers and advisers more connected with (aware and supportive of) program elements. Although communication and engagement strategies have always been elements of InCalf they will feature in this round (accounting for a significant proportion of the budget).

### **These outcomes will be achieved through five areas of activity:**

- › Tabling of an industry plan for herd fertility
- › Delivery of new technical material through the module “Cow health and transition management”
- › Communications to farmers and advisers featuring the new ‘InCalf Pack’
- › Supported investigations in herds with fertility problems
- › Interactions with industry stakeholders (including RDPs and NCDEA).

### **Industry plan for fertility: conduct a situation analysis and Fertility Forum with outcomes to:**

- › Establish accurate current reproductive performance in the Australian dairy herd
- › Assess trends in reproductive performance over time
- › Assess the application and relevance of InCalf’s key messages to dairy advisers and farmers
- › Assess whether there are other areas additional to InCalf’s 6 key management areas that need investigating. For example:
  - Nutritional management of high producing dairy cows to improve reproductive performance
  - The impact of genetic selection on reproductive performance
  - The profitability of cross breeding as a strategy to improve fertility
  - The profitability of split calving systems over seasonal calving systems
- › Plan a co-ordinated approach to areas that can currently be investigated and identify areas that will require more planning for future research
- › Identify the key components that would make up a herd fertility investigation pack



## The anticipated activities for InCalf in 2011–12 are:

### › AI: Do It Right module

In 2009 this was piloted as a refresher exercise that herd improvement centres could use with clients. The premise was that:

- (i) DIY insemination takes a series of steps, any of which can reduce performance in “keeping semen alive, and getting it to the right place”. (In the original InCalf research DIY operators achieved less pregnancies than professional AI technicians in the same herds.)
- (ii) The most effective refresher experience for a farm is review with a competent professional inseminator, onfarm, with all the staff involved, in the farm facilities
- (iii) Semen resellers would find an onfarm experience of this nature an appealing product to enhance their client relationships. NDFS results this year estimated over 6000 people do inseminations on Australian dairy farms.

The plan is to work with 100 farms serviced by 10 HI centres with the objective to identify where the problems are on farm and at the same time help advisers who service DIY clients develop their skills, confidence and motivation to start working in the area. Ultimately the objective is to have farmers confident and capable with using AI. This work was originally proposed for 2010-11 but has been held over given resource allocation to the Review.

### › Establish gaps in knowledge—data analysis and likely field research

A preliminary outline of likely program of work:

- Build on the InCalf messages for the modern, high producing Holstein herd
- Validate and improve Fertility Focus Report and InCalf NatScan
- Develop an InCalf Fertility Investigation Pack and up skill advisers
- Better manage herd nutrition for improved herd reproductive performance
- Improve central capture of herd pregnancy testing data.

### › Continue the activities to achieve communication with stakeholders, especially interaction with the RDPs

### › Adviser training. No InCalf adviser training has occurred for over 3 years. It is essential to have advisers who are confident and skilled in herd fertility analysis in each region. This would be planned in conjunction with NCDEA

## Genetic Selection for Fertility

Within each breed, there is genetic variation for daughter fertility. Some cows have better genes than others. We can use information from a large population of herd recorded cows to evaluate animals for daughter fertility.

Daughter fertility ABV is expressed as a percentage more or less than the average of 100 and is a breeding value that attempts to predict differences in 6 week in calf rate. A bull with an ABV of 104 is said to be 4% above average for daughter fertility. This does not translate to a 4% increase in 6-week in-calf rate in this bull's daughters as only half of the daughter's genes come from the sire and because actual herd performance is the result of genetics and the management of cows (environment).

Currently, about 4% of the variation in daughter fertility between animals can be explained by genetics. However, farmers are encouraged to ensure it is part of the breeding objective. It doesn't cost much and can yield small but cumulative results over time.

Fertility ABVs have been produced in Australia since 2003 although only a proportion of the published available bulls have a daughter fertility ABV of high enough reliability to be published. At the same time, fertility was included in the Australia Profit Ranking (APR). Since this time, the declining genetic trend for fertility has stabilised.

In the recent APR review, fertility was a trait of significant interest. The new formula applies extra emphasis on this trait. The response to selection, with APR as the basis for selection, is expected to be about 5% over a 10 year period. Whilst small, many other countries are still showing a negative response in their respective national indices.

ADHIS also produces semen fertility values for bulls with more than 400 matings. Semen fertility values are not breeding values. They are based on historical mating information and do not necessarily predict future performance. Most bulls fall within 2.5% of the average but there are some bulls that are better or worse. This information is made available on the ADHIS website. A technote is attached below which describes semen fertility values in more detail.

## Genetic Improvement of Fertility

Fertility is economically important trait. However, the current fertility Australian breeding values (ABVs) have low reliability because of low heritability and imperfect data capture of all relevant data. This results in difficult modeling for genetic evaluation purposes.

One reason for this is that reproductive records of individual cows are often censored because subsequent calvings of cows that re-calve late are usually lost or the cow does not re-calve (i.e. the cow never appears again in the database).

The stability and reliability of fertility breeding values could be improved by accounting for censoring of fertility and using additional information on culling, milk yield, mating, calving and pregnancy test data. In turn, this would lead to improved genetic progress in fertility through greater industry uptake of fertility ABV, and better selection decisions.

Improving the phenotypic data and reliability of ABVs for fertility has strong links to the current ADHIS effort to implement genomic selection. By increasing the accuracy of fertility ABV for currently used bulls, we should see a corresponding increase in the reliability of genomic BVs for young bulls.

Current research is aimed at a ready to implement method for calculating fertility ABVs that are more reliable through identification and use of traits that could be readily utilised in a multi trait model to improve the reliability of fertility ABVs.

## Integrated Industry data to support on-going R,D&E

Genetic improvement and other dairy R,D&E activities rely on data collected through herd recording and industry initiated projects and tools. We need to ensure that there are effective data capture and transfer measures in place if we wish to increase the amount of data captured in order to select for fertility and health. However, the herd recording system is under great pressure and there is a fragmented dairy data system.

Traditionally about 50% of dairy farmers participate in herd recording. However numbers have declined by 1/3 in the last 2 years. Potentially the number of farmers herd recording could continue to decline and this may impact on the amount of data able to be used in herd management, genetic evaluation and other R&D projects.

If the industry seeks to utilise national commercial data from farms in supporting and underpinning future R,D&E an improved dairy data system is required. An initiative under the National Herd Improvement Association

(NHIA) has undertaken to review dairy industry data with the desire to investigate the value proposition for improving data collection, quality & quantity, transfer & access in the Australian dairy industry by consulting extensively with all sections of the industry. A report was released in August 2010 with the next steps in this process currently being developed.

## Extension and Education Services

Once R&D in the area of genetics and fertility improvement is complete there is a need to effectively extend outcomes from this research to the industry.

## Genetic Gain

Two reviews have identified the need for ADHIS extension resources be directed towards clearer and more inclusive messages around bull selection (Genetics Learning Package Needs Assessment, Harris Park, 2009 and Influencing forces—Australian genetic evaluation products—a report to Dairy Australia, the Rural Innovation Research Group, 2010).

The reviews found that ADHIS had developed the information, products and tools to support understanding of ABVs on-farm but more work was needed to promote their adoption on farm. Key recommendations from this process were a focus and brand the effort, actively involve relevant service providers and take a leadership role in delivery of technology relating to genetic improvement on farms.

The concept of a Good Bulls Guide is a bi-annual listing of the list of leading bulls, ranked according to their APR. Within the Good Bulls Guide are lists of trait leaders for traits such as type and survival. Bulls of higher reliability can also be identified separately.

As the Good Food Guide directs consumers interested in a good night out to tried and tested eateries (where the best rate one, two or three Michelin hats), the Good Bulls Guide would direct farmers to 'highly recommended' bulls. For this concept to work, people must want to use the information and believe in the ratings that are given: which in turn means the rating system used must be credible and free of vested interests.

This approach would be successful if:

- semen resellers use the Good Bulls Guide when deciding which bulls to offer clients
- farmers are keen to use the guide for all semen-buying choices (and confident enough to question their adviser whether the bulls on offer are on this list)
- the system is easy for both farmers and service providers to use.

## Fertility

InCalf has maintained a dairy media presence in the last 2 years to raise farmer awareness about the fertility management topics being supported at the time. This has primarily been based on case studies in The Australian Dairyfarmer (bimonthly), and information 'grabs' in a wide range of dairy newsletters. This will be maintained in 2010–11.

### "The InCalf Pack"

When the 'Cow health and transition management' module is complete a 'Pack' of all the materials for farmers will be created to bring a set of practical farmer technical materials together in one place.

The InCalf modules. Good management is needed on several fronts to get cows in calf as soon as possible after mating starts:

- Bull management (Bulls: Power Up!)
- Heifer growth (Heifers: Big Girls XL)
- Heat detection (Cows in Colour)
- Artificial insemination (AI Do It Right)
- Cow health and transition management.

Herd fertility can be improved by taking action on any one of the modules and the effects are additive (although all need to be attended to be a top herd). The modules form the building blocks of the project extension and education activities. (For more information see the overview report 31 Mar 2010).

New content will be added to make the pack a well rounded stand-alone resource. This includes an InCalf perspective on genetics (links to the Good Bulls Guide and Selectabull), crossbreeding and extended lactation. Information will also be provided on how to get a Fertility Focus report and how to use it to assess reproductive performance.

### InCalf investigations in problem herds

Anecdotal feedback suggests that implementation of the InCalf recommendations has not resolved fertility problems in some herds. This element aims to put the diagnostic elements of InCalf into practice, and build the confidence and problem-solving capacity of local advisers while identifying limiting issues and showcasing the process for farmers.

The approach is to draft a 'Fertility Investigation Pack' then have InCalf experts mentor local advisers involved in fertility investigations in 4–6 problem herds across three different regions. The process and resources will be co-developed and evaluated for others to use.

### Farmer training

Webinar based Diploma of Ag training programs are currently being piloted with NCDEA in each region in Victoria. Genetics and InCalf are incorporated together in the Breeding and Mating unit.

## 3.3. Priorities for further investment including outcomes sought

The following details areas of future investment with respect to current activities.

### Improving the rate of genetic gain for profit

#### Random Regression Analysis for the Production Trait Group

Random Regression is current world's best practice methodology for traits such as production and cell count. Most of the evaluation units in the major dairy nations utilise this type of model for production with some also using it for analysis of cell count. This methodology was researched by and implemented by ADHIS for the cell count trait in 2008. A significant increase in reliability was seen as a result of incorporation of this model. The main benefit of this model comes from the superior ability to analyse variability of data throughout a lactation—which is seen with cell count trait. When applied to the production trait group we also expect to see a beneficial improvement in reliability and a greater ability to handle/estimate persistency in a lactation.

#### Maternal Calving ease / Gestation length

The initial research into calving ease and gestation was undertaken by Dr Sara McClintock as part of her PhD studies. This research outlined the basis behind genetic evaluation for calving traits including maternal calving ease (currently only paternal calving is evaluated) and gestation length. The analysis and release of these traits provide farmers with the ability to manage their calving period, young stock and animal health issues around calving.

#### Inbreeding Co-efficient Calculation

Increase in actual profitability from improving dairy cattle genetically is a balance between the positive effect of selection and the negative effect of inbreeding. Inbreeding has a detrimental effect on fitness traits, such as fertility and lower milk production. Haile-Mariam et al. (2007) estimated that the cost of 1% inbreeding is between 3 and 9 APR units. The rate of inbreeding can be slowed by farmers avoiding mating cows to related bulls and by AI studs testing and marketing unrelated bulls. Selecting the best bull for each cow so that the calf's genetic merit minus inbreeding depression is maximised will ensure maximum rate of genetic gain whilst managing inbreeding within the population.

Traditionally, inbreeding has been quantified and controlled using pedigrees. However, genetic markers can be used to calculate inbreeding more accurately as the inheritance of DNA that is identical by descent can be tracked more precisely.

Activities to better manage Inbreeding:

- › Monitor inbreeding of the population by predicting future cow population every year
- › Calculate and publish expected inbreeding of prospective progeny of bulls that are available in the system
- › Calculate and provide expected inbreeding of prospective progeny of bulls that breeding companies would like to import.

### **Incorporation of International Evaluations into Domestic Genomics Reference Population**

This research proposal is relatively new and was an outcome of discussions at the ADHIS genetics committee. The key issue here is the potential to use Multiple traits Across Country Evaluations (MACE) evaluated bulls in the Australian reference population. Given the amount of genotype sharing likely to take place in the near future this research could rapidly become a high priority area.

The research would focus on whether the inclusion of a large amount of MACE evaluated bulls would bias the domestic genomic evaluation. This research could initially start with a small data set to test the hypothesis and then to a larger data set once one becomes available.

### **ADHIS Genetic Evaluation Database Update**

The system ADHIS uses to calculate ABVs is over 13 years old. This system was built to effectively run genetic evaluation on the resources available to ADHIS at the time. As such its ability to undertake tasks outside of genetic evaluation is significantly limited. In recent years ADHIS has scoped out the re-development of its genetic evaluation system (GES) to meet the following over-riding objectives:

- › **Improve the accuracy of ABVs**—through the ability to incorporate new genetic evaluation models improved data storage and access & quality assurance of input and output data
- › **Utilise a full database system**—currently the GES system is not a true database and many tasks are restricted due to the current architecture
- › **Increase operational efficiency and reduced risk within ADHIS**—through the use of more common computer language and structure resulting in improved speed and accuracy of operations and reduced reliance on key individuals
- › **Incorporate Genomic Data and models**—in order to increase the rate of genetic gain and improve genetic evaluation services to AB companies, farmers and industry

- › **Meet the demand from ongoing development**—through greater ability to update and improve genetic evaluation models, introduce new traits, incorporation of new data both domestically and internationally, production of new reports and industry services.

The genomics functionality has recently been updated within ADHIS however the remaining GES system is still required to be replaced to meet the above noted desire objectives.

### **All Breeds Base**

There are several breeds available to dairy farmers. Logically they should choose the breed that maximises the breeding objective formulated above. Crossbred cattle exceed the average of the parent breeds for many traits related to fitness i.e. heterosis or hybrid vigour. Thus, if there are two breeds of similar profit, the cross between them is likely to be more profitable than either pure breed. To do this requires information comparing the breeds under the same environmental conditions. Research has shown that the gross efficiencies Jerseys and Holsteins is in fact quite similar, where gross efficiency is calculated as milk product per unit of feed eaten. In order to be able to estimate feed eaten, cows need to be weighed. This is already done in New Zealand, where all daughters of progeny-test sires are weighed in first lactation. In Australia, liveweight is predicted using type traits, although there is an initiative (through the Holstein Association) to weigh more cows.

In addition, the Feed Conversion Efficiency (FCE) research currently being undertaken will provide some data to understand differences in efficiency between breeds and together with more liveweight data will assist in developing an all breeds base for ABVs. It may be important to consider selection for a complete objective that includes milk production, FCE and fertility. A trait that was positively correlated with fertility but negatively correlated with FCE might not be a good selection criterion. In calculating feed efficiency it is possible to credit cows that mobilize body tissue with being efficient, when clearly they are not. Failure to correctly disentangle body condition score from efficiency may lead to selection for lower fertility. It is a necessity to estimate the genetic correlations of proposed new traits with all traits in the breeding objective.

Of course many other genetic factors, contributors and variations between breeds need to be considered.

## Improving herd fertility

### Genetics

Genetic improvement for fertility is currently focused on improving the evaluation model for fertility and investigating genetic markers related to improved fertility. These projects involve ADHIS and the DairyFutures CRC. Accuracy of evaluation could also be improved by:

- › More complete recording of existing data such as inseminations, calving difficulty.
- › Recording new traits such as pregnancy diagnosis or milk progesterone concentration.
- › Recording traits that are correlated with fertility such as body condition score or angularity.
- › Larger numbers of daughters per bull.

### Management

Farmer concerns about a trend of declining fertility were expressed during the discussions for Dairy Moving Forward in mid-2010, including a level of uneasiness about the completeness of InCalf's reproductive messages.

Strong financial reasons exist to work through industry's current concerns around fertility of the Australian dairy herd. The dairy industry has a significant investment in improving the genetics of the Australian dairy herd, and for this, cows must get in calf to translate the benefits to farm. There is a cost to farmers with poor in calf rates who are forced to purchase replacement milk cows.

It is recognised that there are currently short-comings in knowledge of national reproductive performance. There are many reasons for this including those outlined following in the data section. Furthermore the historical InCalf data whilst highly beneficial to the commencement of the project is becoming outdated and does not necessarily reflect current national performance.

Current capability, R&D and gaps in knowledge:

- › While many advisers have undergone formal InCalf training the 'active' pool of advisers is actually quite small
- › National fertility data is incomplete without pregnancy testing information. Assessments of key drivers of fertility such as conception rates is then limited
- › Herds move in and out of the ADHIS data base from year to year, which makes it more complex to assess trends in performance

- › Nutritional understanding and management of the modern dairy cow for reproductive performance is an evolving science and one that is not fully understood. Ian Lean and John McNamara are conducting new research into "Metabolic models for reproductive performance"
- › Peter Degaris has recently completed and published research into the transition period management on commercial dairy farms in Gippsland and this periods effect on reproductive performance
- › Carl Hockey (Ph D, University of Queensland) has recently completed research on the performance of systems for automated selection of cows for insemination in both a seasonal calving herd and a year-round calving herd (accepted for publication). He has also assessed effects of AI timing on conception rates, and has modelled performance of systems for automated selection of cows for insemination (both accepted for publication)
- › There is a gap in understanding the causes of poor reproductive performance in herds that perceive themselves to be performing all the "InCalf" elements
- › Rebecca Dickinson, at Warrnambool, is conducting field assessments of the effects of body condition and body weight loss on reproductive performance in a pasture-based herd; similar work is in progress at Massey University in NZ
- › The massive National Dairy Fertility Study (NDFS) in NZ will provide information invaluable for the Australian dairy industry about manager responses to InCalf training programs, effects of such training on reproductive performance and extensive social science around these areas
- › Effects of failure to conceive and extended lactations on fertility—Ellinbank research.

R,D&E activities directed to the below objectives will help to achieve:

- › An improved understanding of the causes of reproductive performance. This greater knowledge will help farmers re-focus on key reproduction strategies under their control
- › Industry clarity around causes of poor reproductive performance
- › Increased confidence and ability to improve reproductive performance
- › More targeted industry investment in reproductive performance.



## R,D&E priorities are:

### › Tabling an industry plan for herd fertility

- Establishing the gaps in knowledge – data analysis and likely directions for field research. This will occur in 2010–2011 as part of the InCalf review
- A situation analysis will be conducted which will include surveys from both farmers and advisers and some preliminary data analysis
- Small working groups will form on key areas to report back to a Fertility Forum, planned to run early in 2011
- Key industry needs and issues to be identified
- Plan for a co-ordinated approach to areas that can currently be investigated and identify areas that will require more planning for future research.

### › Improved understanding of causes of reproductive performance

- Compare current reproductive performance being achieved by high producing herds (> 8,000 litres/cow/year) and lower producing herds (<6,500 litres/cow/year), and identify genetic and non-genetic reasons for differences in reproductive performance between individual herds; including reasons for differences between high and lower producing herds, should there be any
- Establishing high producing (> 8,000 litres/cow/year) / high reproductive performance 'demonstration herds' in major dairy regions for incorporation into InCalf's extension program
- Investigating herds experiencing low reproductive performance despite reported good performance in the 6 key herd management areas identified by InCalf
- Validating and improving Fertility Focus Report and InCalf NatScan
- Developing an InCalf Fertility Investigation Pack tool.

### › Better physical and financial data collection and use on farm

- Better understand data flow through paper and software-based systems used on farm and by veterinary practices and herd improvement centres
- Assimilate pregnancy testing data and animal health events that are stored off-farm in Veterinary practice repositories, into a central data system. More accurate fertility measures such as actual 6 week in-calf-rates and conception rates will be obtainable; current performance and trends

assessable; issues can be identified for follow up or further research, with increased reliability of fertility ABV's

- Increase the amount of data from more herds
- Increases ability to make timely on farm decisions, farmers view data as valuable resource and act on data.

### › Better management of herd nutrition for improved herd reproductive performance

- Investigate effects of nutrition in early lactation and the mating period on reproductive performance (submission rate and conception rate), including effects of strategies to reduce the extent of body tissue / body condition loss in early lactation, and effects of varying energy and rumen degradable protein intakes during the mating period
- Complete the transition cow "nutrition" story- technical review and extension messages associated with nutrition from calving to joining for reproductive benefits
- Develop better tools to help farmers and advisers monitor nutritional status of cows and herds during early lactation and the mating period (beyond the 'quick nutritional checks' already described by InCalf and feed.FIBRE.future programs).

### › Supporting investigations in herds with fertility problems

- Understanding the causes of reproductive failure
- Improving the capabilities of field advisers to perform reproductive investigations.

### Adviser training/Fertility Investigation Pack.

- The Adviser Engagement Strategy has involved redesigning resources and directing contact with advisers on singular components of InCalf's messages. To enable change to occur on farm, it is essential to have advisers who are confident and skilled in herd fertility in each region. Future InCalf adviser training programs would be planned in conjunction with NCDEA
- Developing a Fertility Investigation Pack is an integral step towards improving advisers' capability to perform a reproductive investigation. Integration of knowledge into action is also an on-going challenge- there is innovative work currently occurring in New Zealand, which should be mutually beneficial to both projects.

## Improved industry data to support on-going R,D&E

### Consolidated Dairy Data

An NHIA report was released in August 2010. This report effectively calls for significant industry leadership and funding in progressing the initiative. The next step is to analyse the proposals in detail to clearly document the benefits to farmers and to industry from the required investment. Understanding the drivers behind data capture and the data needs of farmers to support on-farm decision making is required.

This taken, a more unified and consolidated dairy data system can be viewed as an invaluable asset of the industry in both supporting on-farm decision making, meeting compliance measures, providing data for genetic evaluation and the backbone for industry analysis and broad R,D&E within the dairy industry. The full data report can be obtained from NHIA.

### Additional Data

The future genetic improvement program needs not only the traditional herd recording data but additional data on, for instance, fertility and health. The key is to clearly outline the value proposition for farmers in recording data. Possible measures to alleviate this situation might be:

- New on farm technologies to reduce the labour cost of herd recording such as electronic cow id, bar coded milk samples, electronic milk meters that record volume automatically, hand held computers for recording 'event data', capturing liveweight data from walk over weighers.
- New services that increase the value of herd recording to the farmer such as the fertility focus report and herd management reports
- Commercial value placed on the value of stock with data records
- New services that increase the value of the data to other clients such as milk factories, AI studs, veterinarians, management or nutrition consultants, national disease monitoring, Dairy Australia, In-Calf, ADHIS, researchers
- Rationalisation of the software supporting herd recording so that it can be efficiently maintained and upgraded
- Rationalisation of on-farm software so that data can be up loaded to the herd recording centre or ADHIS more easily
- Concentration of herd recording on farms participating in progeny testing bulls and greater involvement of the AI studs in collecting the data

Genomic data is currently begin incorporated into ABVs currently however this will not eliminate the need for recording relevant traits on commercial cattle. This factor may not be broadly appreciated and as such data for all animal related R,D&E activities may be impacted. The tables included in Appendix 1 outline these areas noting the objectives, expected outcomes and who should be involved.

## 4. Strategic Priority Area 2: Improving capacity for genetic improvement through genomic and reproductive technologies

### 4.1. Overview

Substantial improvements in the genetic selection of cattle can be achieved with genomic and reproductive technologies. This will drive productivity growth and facilitate the current market demands to be able to breed according to a diverse range of breeding objectives.

#### Desired industry outcome

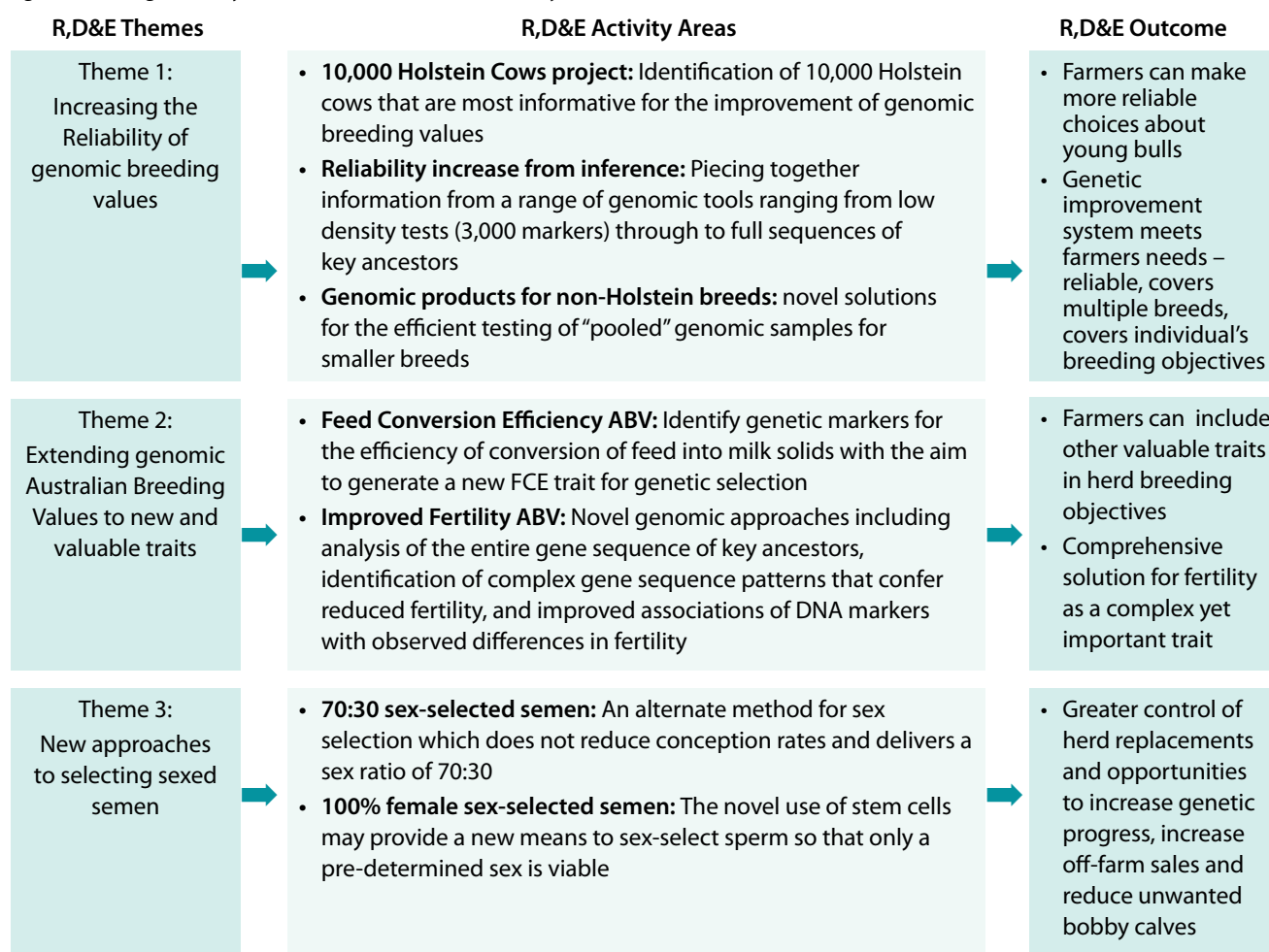
Genomic technology is essential for the sustainability of Australian Breeding Values (ABV), ie the domestic capacity to measure genetic merit. It is a positive technology, where it can double the rate of genetic progress and also deliver reliable breeding values that meet individual farmers' breeding objectives. It is also a critical technology, where the counterfactual case of not having a domestic genomic technology would quickly handicap the ABV system against the import of genomic technology.

Implicit in all discussions about domestic capacity to produce breeding values is the consistent observation that non-domestic breeding values have a similar reliability as a long-term weather forecast, as compared to the excellent reliability produced by existing measurement of progeny and the planned outcomes from the CRC's genomic research program.

An efficient genomic test will have far-reaching consequences for sourcing the best genetics for use on Australian farms. This search can/should be an international search and will discover new sires, irrespective of the country that they stand in, that will benefit Australian farmers.

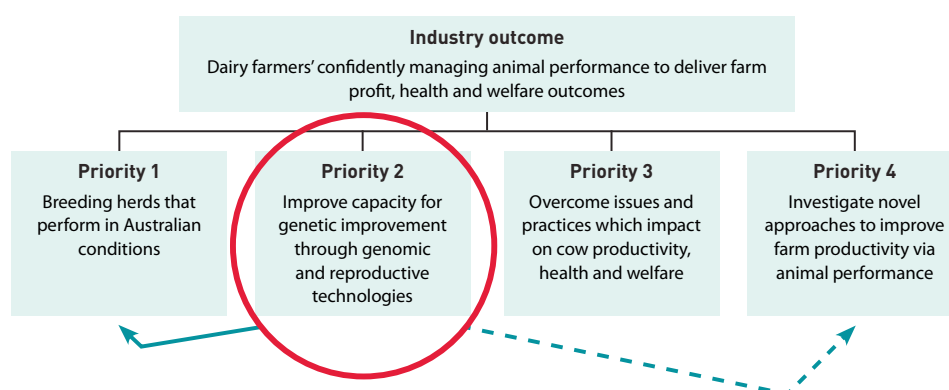
An efficient genomic test will also facilitate the use of advanced reproductive technologies (such as IVF) that will drive genetic progress through the rapid identification of young stock with elite genetics. Elite males can be enrolled at puberty (~13 months) and elite females before puberty (~6 months).

Figure 5. Strategic Priority Area 2 R,D&E themes and industry outcomes



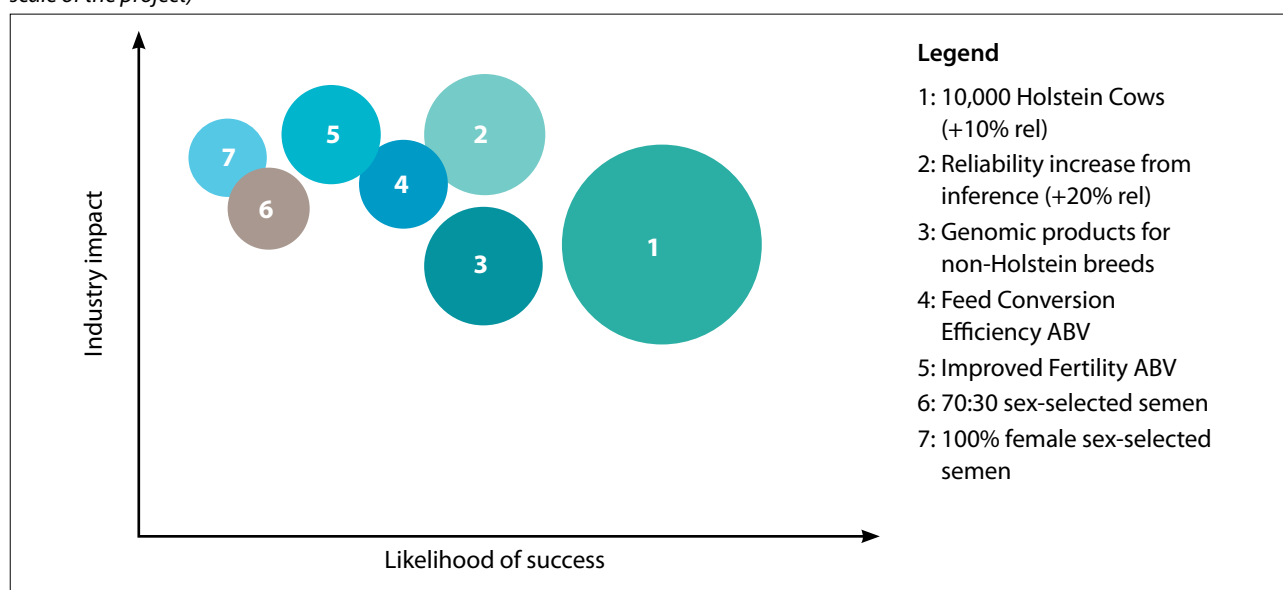
The ability to favour female calves through the use of sex-selected semen has numerous benefits. First, it increases genetic progress through the ability to be selective of which heifers to rear. Second, fewer male dairy calves reduces the scale of rearing bobby calves. Third, it offers greater flexibility to farmers based on expected markets for different progeny. Some years it might be worthwhile to maximise the number of dairy replacements for own use or for export, while other years it might be worthwhile to also breed some dairy-beef calves for sale into the beef market.

The primary link of Priority 2 is to deliver new technology into Priority 1, and to also be guided about its prioritisation of effort based on objectives in Strategy 1. Priority 2 can also utilise new technology from Priority 4 for novel traits based on advanced sensing technologies. There are also minor links to Priority 3 in terms of reduced bobby calves and genetic improvement of health and mastitis traits.




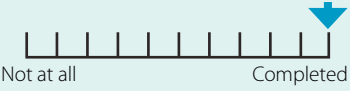



## Impact vs Success

Figure 6. Ranking investment priorities in Priority Area 2 – Industry impact versus likelihood of success (size of the bubble indicates scale of the project)\*



\* Estimations of impact, likelihood and scale of project are qualitative only and reflect the opinion of the Dairy Moving Forward expert working group

## Capabilities available and required

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		Yes. Organisations have committed through participation in the Dairy Futures CRC
Do these people and organisations represent the majority of prior learning in this area?		Yes. Participants have previously been involved in CRC for Innovative Dairy Products and/or DPI Victoria
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		Yes. The main beneficiaries will be farmers, with additional benefits to co-investors
Would the collaborators be able to provide diverse avenues for change?		Yes. Participants include ADHIS, Dairy Australia, DPI Victoria and commercial service organisations
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		Yes, largely. There are additional opportunities for investment that could be realised.

In the 'Dairy Moving Forward (A National Research, Development and Extension Strategy, 2009)' report, the R&D capability in animal breeding and genetics was assessed and concluded that there is a shortage of skilled staff in this area. Of concern is that core requirements will increase or become more important in the short to medium term (Table 1).

Peverill and Oates (2010) made the same observations and warned that the age profile of R&D staff in this strategic area are older (and more experienced) than those working in the Feedbase area, which has more than half of its staff under 35 years. However, of the scientists (qualified with PhDs) and working on Dairy Future's CRC Animal Platform 2 projects, around half are under 40 years of age and is comparable to Feedbase.

Investment is being made in training young scientists in order to build capability in animal breeding and genetics for the future and in doing so, partly address the gap identified by DMF (2009) and Peverill and Oates (2010). Six PhD students funded by the Dairy Future's CRC have already commenced their studies. In total it is expected that 10 PhD students will be trained through the Dairy Future's CRC. Attracting high calibre students with strong mathematical and statistical skills required for quantitative genetics and genomics research remains a

sizeable challenge in recruiting suitable PhD candidates.

The laboratories at DPI Bundoora have state of the art equipment enabling high-throughput genotyping and sequencing to be performed quickly and effectively. Considerable investment has been made in sequencing and genotyping equipment, with an emphasis on improving efficiencies and throughput. For example, where possible laboratory tasks have been automated using robots, so that human intervention is minimal. Genotyping and sequencing work generates very large datasets that have considerable requirements for data storage and analysis.

Capability gaps have been identified on handling and analyzing these very large datasets. This gap has been partly addressed through training staff and students and through investments in computing. Recently, \$2.4million has been invested in an Advanced Scientific Computing Centre at Bundoora and includes 3 dedicated staff members responsible for rapid processing of data. In addition, Australia's largest research facility for agricultural biosciences is currently being built at the La Trobe University Campus, Bundoora. Completion is scheduled for 2012 when it will house around 400 DPI/La Trobe University staff and students, including many of the scientists involved in Dairy Future's CRC animal research.

**Table 1. Animal Breeding and Genetics R&D capability analysis taken from *Dairy Moving Forward—A National Research, Development and Extension Strategy* (2009).**

	2009	1–5 yrs	5–20 yrs
Animal Breeding (includes genetics) and Animal Reproduction	Inadequate	Core	Core →



## 4.2. Existing investment activities (CRC) & key past investments

The major investment in this strategy is the Dairy Futures CRC. The CRC will consider investments across the full range of Strategy 2 initiatives. Much of the research agenda is a continuation of significant efforts by the CRC for Innovative Dairy Products and DPI Victoria (through a series of regional landscape grants).

## 4.3. Priorities for further investment including outcomes sought

The leveraged support of public funds from state and federal level, from levy payers and from commercial partners provides a rare opportunity to build a large program of work that can concurrently address a range of major outcomes.

Many of the CRC projects are inter-linked in terms of resources used and impacts derived, however this will not be considered in the sections below to avoid over-complication.

### 1 Timing of Investment Priority

The two drivers of timing are capacity to invest and completion of pre-requisite projects. Capacity to invest is a combination of financial resources (cash and in-kind) and availability of scientists and students. An example of the need to complete a pre-requisite project is the need to collect 10,000 Holstein cow genotypes before work can commence to use “inference” technology.

A comprehensive set of milestones for the whole CRC program have been developed as a requirement of Commonwealth funding, and these milestones describe the relative timing of each major activity. An Impact Template has also been prepared that documents the timeframe of activities, outcomes, usage and impact. A skills-based board and management of the CRC have responsibility for oversight of activities, timing of activities, meeting existing contractual arrangements and completing external review/evaluation of work performed.

### 2 Description of current work program

- **10,000 Holstein Cows project – short term.** This is one of the major projects commissioned by the CRC. It involves the identification of 10,000 Holstein cows that are most informative for the improvement of genomic breeding values. The goal is to double the size of the reference population. This has the potential to increase reliability of breeding values by 10%, which would then be comparable with the minimum standards for progeny testing. Associated activities include genotyping informative bulls and validating the use of cow data to calculate breeding values. A large additional grant from Regional Development Victoria has been received by Dairy Australia for this project.
- **Reliability increase from inference – medium term.** This is a cutting-edge approach that seeks to fill in gaps in knowledge about individual animals based on understanding their pedigree. It involves piecing together information from a range of genomic tools ranging from low density tests (3,000 markers) through to full sequences of key ancestors. Success will build on all existing work and provide a boost in reliability (up to 20% greater reliability than the initial product launched by ADHIS in September 2010). This project is closely linked to Part A.
- **Genomic products for non-Holstein breeds – short/medium term.** Current technology has focused on the Holstein breed as it is the only breed large enough to build a comprehensive reference set (the current set is 2,500 bulls). The next nearest breed is Jersey (with 400 bulls), and tests have shown that the same approach cannot be used for smaller breeds. Short term activities include building the number of bulls in the reference set, and medium term activities include novel solutions for the efficient testing of “pooled” samples. This is a riskier approach, but is considered necessary to deliver a cost-effective test for smaller breeds.
- **Feed Conversion Efficiency ABV – medium term.** This is an ongoing activity with support from the Gardiner Foundation and collaboration with DairyNZ/LIC in New Zealand. The objective is to be able to directly measure the efficiency of conversion of feed into milk solids as a new trait for genetic selection and predict it using genomic selection tools. The project is at a critical stage with two lines of heifers (high and low feed efficiency) selected from 1000 growing heifers being tested as milking heifers.. This would be the first example of a trait that is too difficult/expensive to measure on farm that can be assessed with genomic tools.
- **Improved Fertility ABV – medium term.** Fertility is a complex trait that is poorly recorded and also has low heritability. This has restricted past attempts to improve its efficacy as a trait. Meanwhile, farmers are reporting systematic failures where large proportions of cattle are not becoming pregnant or have delayed pregnancies. Genetic variation exists with large differences between the best and

worst sires. The low heritability of fertility arises from the large environmental/management/nutrition component. The current project aims to harness a range of novel genomic approaches including analysis of the entire gene sequence of key ancestors, identification of complex gene sequence patterns that confer reduced fertility, and improved associations of DNA markers with observed differences in fertility.

- **70:30 sex-selected semen – medium term.** Sex selection is a desired outcome, and the use of current commercial products demonstrates the potential take up of the technology. Current technology suffers from low conception rates due to the sex-selection process. This project seeks to find an alternate method for sex selection which does not reduce conception rates and delivers a sex ratio of 70:30. This is a risky new approach and will be investigated in stages.
- **100% female sex-selected semen – medium/long term.** The novel use of stem cells may provide a new means to sex-select sperm so that only a pre-determined sex is viable. This project is established and has passed a number of technical milestones. However, it remains a risky approach and the outcome is of a medium/long term nature.

### 3 Possible future investments

Possible future investment is likely to include additional investment in some of the seven current investment areas as well as alternate investment areas. Many of the current investment areas would require substantially greater investment if they demonstrate that they are prospective or if a speedier outcome is desired.

New investment areas may include:

- improvements to reproductive technologies required to accelerate genetic progress at the level of breeding companies
- investment to determine the function of key genes
- investment to validate new approaches using field data
- investment to ensure genomic technology is re-calibrated on a regular basis against field data.

## 5. Strategic Priority Area 3: Overcome issues and practices which impact on cow productivity, health and welfare

### 5.1. Overview

#### Background

In considering how best to describe the essential elements of managing animals for optimal health and well being it was decided to consider three sub-programs as follows (Figure 8):

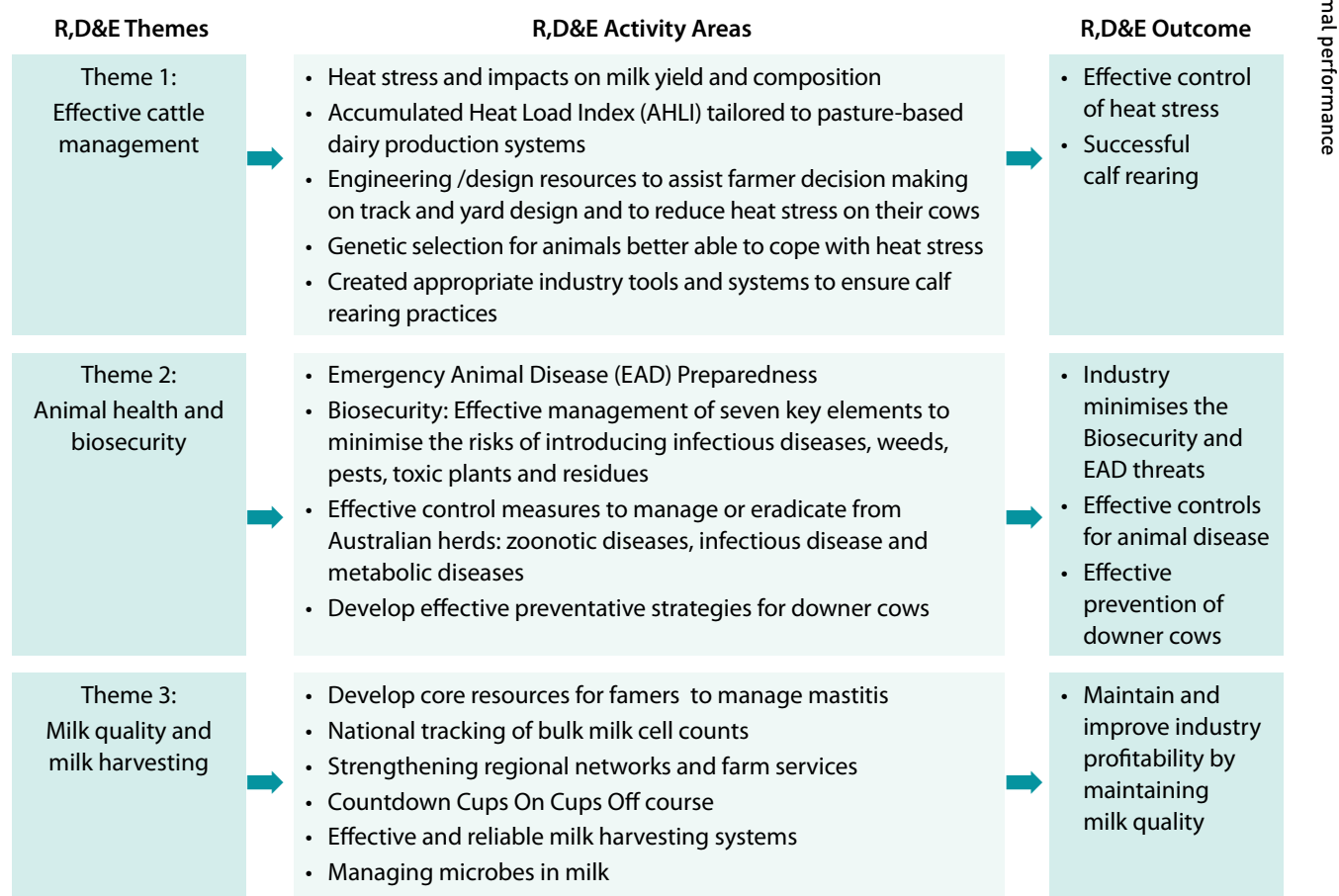
- Animal Health
- Milk Quality/Milk Harvesting
- Cattle Management

The Cattle Management sub-program is largely concerned with optimising the interaction of animals and humans in the built environment on dairy farms. Particular emphasis is placed on the control of heat stress, calf rearing, and prevention measures to avoid animal lameness.

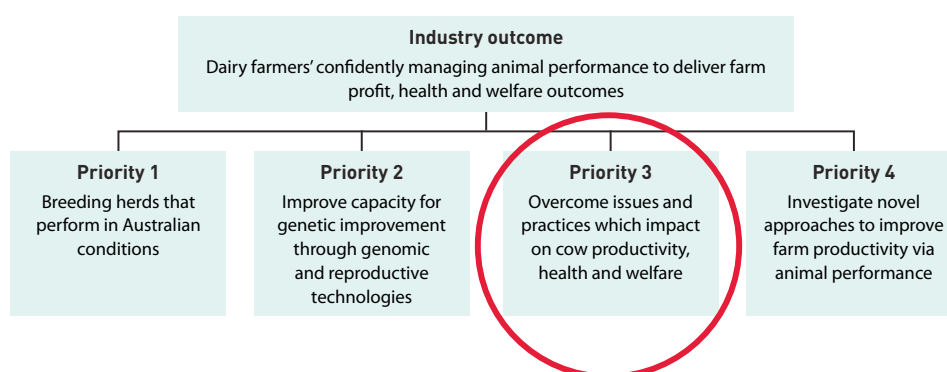
Animal Health considers the preparedness of the dairy industry to prevent and respond to animal disease outbreaks in order to minimise the biosecurity risk and optimise the welfare of animals across the dairy industry.

The milk quality and milk harvesting chapter in this report provides broad guidance for the dairy industry in the area of milk quality and milk harvesting over a 5-year horizon with particular emphasis on the control of mastitis.

Figure 7. Strategic Priority Area 3 R,D&E themes and industry outcomes



Animal Health and Milk Quality & Milk Harvesting are located in Animal Performance, Strategy Priority 3



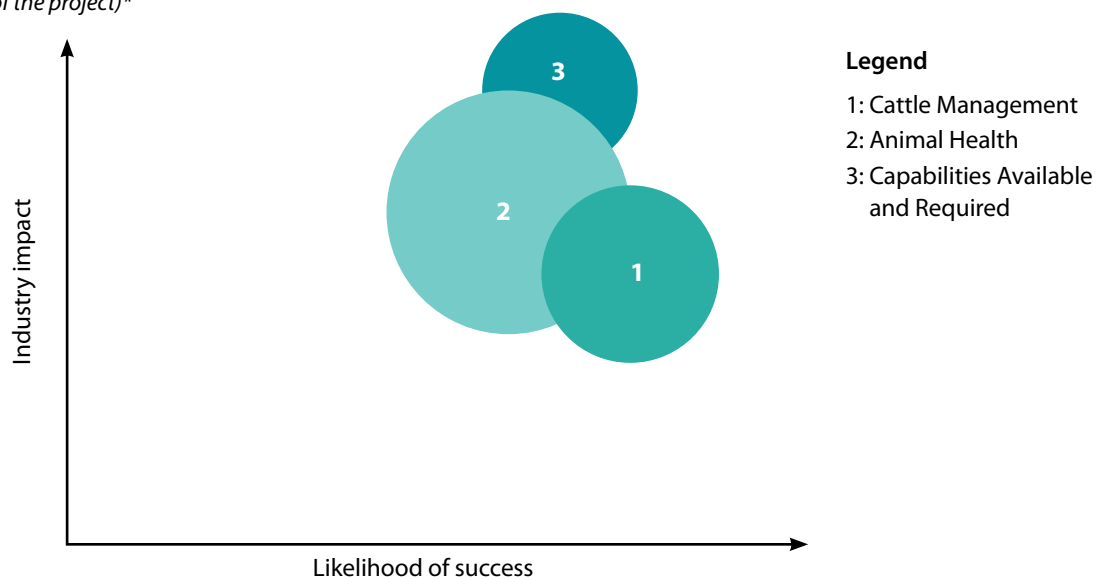
### Desired industry outcome

The Australian dairy industry has had an enviable reputation for establishing and extending best practice approaches to managing important aspects of animal production such as mastitis/milk quality control and reproductive management.

This strategy priority aims to identify the key elements of industry capability that are required for the Australian industry to manage animals for optimal health and wellbeing.

## Impact vs Success

Figure 6. Ranking investment priorities in Priority Area 3 – Industry impact versus likelihood of success (size of the bubble indicates scale of the project)\*



\* Estimations of impact, likelihood and scale of project are qualitative only and reflect the opinion of the Dairy Moving Forward expert working group

## Capabilities available and required

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		Relevant organisations exist with improvements in collaboration possible
Do these people and organisations represent the majority of prior learning in this area?		The majority of learning exists in these organisations
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		Benefits from investment are likely to minimise existing market failure
Would the collaborators be able to provide diverse avenues for change?		Current avenues well developed but new avenues would need to be explored to maximise benefits from investments
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		Most probable cause of market failure is lack of either capability or effective delivery

## 5.2. Cattle management

### Cattle management priorities

A recurrent theme in this sub-program has been the lack of information for farmers on engineering aspects of the built environment on dairy farms. The cost of dairies and all the associated areas such as yards is huge and, in addition, there are requirements to build and maintain other essential facilities such as farm tracks, calf rearing facilities and feedpads. There are local contractors and builders in most regions who vary in expertise and experience but, apart from word of mouth and occasional articles, there does not appear to be any systematic way to exchange information on successful (and unsuccessful) innovation. More importantly, there does not appear to be an Australian source of information on specifications for such things as laneways, calf housing and structures to provide shade for cows or any active research on these matters.

The priorities for this sub-program are:

- › Quantitative information on the relationship between the level of heat stress and impacts on milk yield and composition in herds in sub-tropical / tropical versus temperate dairy regions
- › Assessment of the merits of using an Accumulated Heat Load Index (AHLI) tailored to pasture-based dairy production systems used in Australia which overcomes the limitations of the current measure of Temperature Humidity Index (THI)
- › Provision of engineering information and services to provide information for farmers wishing to install structures to reduce heat stress on their cows
- › Screening and genetic selection for animals better able to cope with heat stress
- › To ensure that all people working across the supply chain are aware of and are delivering on their responsibilities for good calf health and welfare outcomes
- › Ensuring that recommended calf rearing practices are underpinned by robust science and supported by appropriate industry tools and systems
- › Assessment of the significance of neonatal diseases and the most effective means of treatment
- › Assuring Government, consumers and the public that the calf supply chain is well managed
- › Review of information available to farmers on track and yard design and maintenance
- › Provision of engineering /design resources to assist farmer decision making on track and yard design and maintenance.

### Heat Stress

With shifting weather patterns and a trend towards higher temperatures associated with climate change, heat stress is an emerging issue for herd managers in all dairying regions of Australia.

The impacts of heat stress on dairy cattle have been well documented. Heat stress results in:

- › Reduced feed intake and increased energy requirements for maintenance
- › Reduced milk production
- › Reduced fertility
- › Lower milk quality
- › Increased frequency of health-related issues e.g. mastitis, rumen acidosis and ketosis
- › Reduced animal welfare.

Without effective mitigation and adaptation strategies, heat stress will result in increasingly significant losses in income and increased management costs on Australian dairy farms.

There appears to be a better understanding of the impacts of heat stress in the northern dairying regions of Australia (Northern Victoria, NSW and Qld) but there is also much to be gained by implementing strategies to mitigate the impact of heat stress (including heat wave events) in southern dairying regions including Gippsland, Western Victoria, South Australia and Tasmania

### Desired Outcomes

To develop the capacity of Australian dairy farmers to deal effectively with heat stress and minimise its impacts on herd productivity, fertility, health and welfare (and avoid unnecessary changes in farm production systems)

Key components:

- › General information on heat stress and its impacts on dairy cattle
- › Processes, information and tools to support farm infrastructure investment decisions regarding cooling infrastructure such as trees, shade structures, evaporative cooling systems, and to develop and implement herd management and feeding strategies
- › Tools to help farmers assess herd susceptibility, anticipate and effectively manage excessive heat load events during hot season, look back on impacts of heat stress on past herd production and reproductive performance

An integrated, whole-of-year approach is required which ensures dairy farmers not only make the best use of the resources they already have, but also add to their ability to deal effectively with heat stress from year to year.



### Gaps in knowledge

- › The nature of the best measure of heat impact on dairy cattle in pasture-based production systems which accounts for both the intensity and duration of cows' exposure to heat load (Accumulated Heat Load Index)
- › Shade requirements for dairy cows to provide optimal welfare and performance cost effectively (recommended values range from 2–12 m<sup>2</sup>/cow)
- › The effects of heat stress on dry cows and during transition (long term effects impacting on future reproduction, health status of cow and calf, and milk production)
- › Understanding of heat stress physiology (including the effects of heat stress on nutrient utilisation) and animal responses to dietary interventions aimed at overcoming these changes in nutrient utilisation and assisting thermo-regulatory mechanisms
- › Herd nutrition management strategies to reduce the impact of heat stress
- › Quantitative information on the relationship between the level of heat stress and impacts on milk yield and composition in herds in sub-tropical / tropical versus temperate dairy regions
- › The ability to match meteorological and production data to predict when to implement heat stress management strategies.

### Gaps in adoption of recommended practices

Farmers wishing to reduce the impact of heat stress have relatively easy access to high quality information and tools in the Dairy Australia Cool Cows project. The information is supported by workshops and other extension activities but, to date, uptake has been modest. It is considered that uptake might be improved by such measures as:

- › Tools that can be used to better predict when adverse heat effects are likely to be encountered, and their impact on cow heat load
- › Tools to undertake cost benefit analyses of farm infrastructure options available to reduce heat stress
- › More detailed engineering information and better access to engineering support services to assist design of robust, inexpensive shade structures to manage heat loads
- › Advice on ways to reduce water use for cooling cows.

### Priorities

- › Quantitative information on the relationship between the level of heat stress and impacts on milk yield and composition in herds in sub-tropical / tropical versus temperate dairy regions
- › Assessment of the merits of using an Accumulated Heat Load Index (AHLI) tailored to pasture-based dairy production systems used in Australia which overcomes the limitations of the current measure of Temperature Humidity Index (THI)
- › Provision of engineering information and services to provide information for farmers wishing to install structures to reduce heat stress on their cows
- › Screening and genetic selection for animals better able to cope with heat stress.

### Calf Rearing

A key priority of the National Dairy Industry Animal Welfare Strategy is to ensure that all calves are managed across the calf supply chain to meet agreed industry practices and standards. To achieve this goal Dairy Australia has worked with key elements of the industry to develop the Calf Management Program to address the health and welfare of all dairy calves and includes communicating with farm workers, transporters, saleyard operators and meat processors.

### Desired Outcomes

There are three objectives within the Calf Management Program which are to:

- › Ensure that all people working across the supply chain are aware of and are delivering on their responsibilities for good calf health and welfare outcomes
- › Provide assurances to government, consumers and the public that the calf supply chain is meeting its responsibilities
- › Confirm that recommended practices are underpinned by robust science and supported by appropriate industry tools and systems.

### Gaps in adoption of recommended practices

- › There is a lack of information that can be used by farmers to design and construct housing for calves that maximises animal productivity and welfare in a cost effective manner. This lack of good advice also applies to some equipment such as automatic calf feeders that may have been designed for different dairy production systems

- › In addition to the need for better advice on housing there was also a need for reliable, consistent, independent information on such things as vaccination schedules, humane euthanasia, the requirements for colostrum and factors increasing the risk of residues. It is believed that farmers are exposed to a lot of information that is not always reliable
- › Clear information on colostrum feeding (quality, quantity and timing)
- › Clear information about optimum growth rates, weight goals for calves and the best time for weaning
- › Post-weaning management including parasite control.

### Capabilities

- › There are a limited number of people that are capable of delivering farmer training on good calf rearing practices.

### Priorities

- › To ensure that all people working across the supply chain are aware of and are delivering on their responsibilities for good calf health and welfare outcomes
- › Ensuring that recommended calf rearing practices are underpinned by robust science and supported by appropriate industry tools and systems
- › Assessment of the significance of neonatal diseases and the most effective means of treatment
- › Assuring Government, consumers and the public that the calf supply chain is well managed.

### Lameness

In Australia, lameness is considered to be the third most important animal health problem after mastitis and infertility. There are a wide range of foot and limb conditions that can cause lameness and surveys have demonstrated that the predominant causes are related to conditions of the claw of the foot. The relative importance of the various conditions varies between farms and it has been shown that there have been changes over time. Being able to define the nature of the lameness is important because treatment options depend on the nature of the lesions. In Australia it is estimated that between 6 and 10% of animals become lame each year but it is important to remember that this can vary considerably between farms.

There are many factors involved in causing lameness and, on any one farm, they are likely to be interacting in a multi-factorial manner. Environmental factors include track maintenance, weather conditions, yard design, nutrition and the way animals are managed while being brought to the yards and waiting to be milking. In addition to the environmental factors there are genetic influences resulting from conformation especially of the feet.

The cost of lameness includes loss of milk production, cost of treatment, reduced fertility and culling due to lameness or consequential reasons. A recent Australian assessment indicated that the cost of each case of lameness was \$A220.



### Desired Outcomes

- › Less cows becoming lame
- › The cause of lameness being correctly diagnosed and cows being treated appropriately.

### Gaps in knowledge

- › A considerable amount of research and development has been undertaken in other countries including NZ. This latter work is considered to be relevant to Australian conditions. The biggest knowledge gaps appear to be challenges in matching locally available materials to engineering specifications for track and yard construction and maintenance.
- › Nutrition is a factor in causing or pre-disposing to lameness and is less well understood than the environmental and genetic contributions to lameness. This subject is an overlap area with the Feedbase and Nutrition Program and it is anticipated that it will be addressed in appropriate sections of the report on this program.

### Gaps in adoption of recommended practices

While the occurrence of lameness is an on-going issue many of the preventative measures such as track construction and maintenance and training of stock people is episodic and prompted by needs, availability of finance and environmental factors such as weather conditions. The approach that has been adopted is to have a stock of resource materials and people available to conduct workshops in response to farmer demand. The Regional Development Programs and private veterinary practitioners usually coordinate these activities and Dairy Australia maintains the resource material. This approach works well for the people that are involved but is dependent on having local enthusiasts pressing for a workshop. There is potential to have a project led

by a recognised expert who can monitor the situation and ensure that there adequate R,D&E activities to meet farmer needs.

### Capabilities

There are a number of veterinarians who have an excellent knowledge of treatment and prevention of lameness. These people periodically contribute to workshops and help keep resource material up to date. In some dairy districts there are contractors with considerable knowledge about track and yard design/ maintenance and have access to appropriate materials at a reasonable price. The weakness is that this expertise is not available in all districts.

One of the deficiencies of the current arrangements is that there is no dedicated R&D commitment to engineering aspects of track and yard design. The principles of this subject have, of course, been well researched by civil engineers but there are gaps in our knowledge of the interface between cows, stock people and the built dairy farm environment.

### Current R,D&E

There is no dedicated research commitment to dairy cattle lameness in Australia but the industry is fortunate that there has been a long commitment to relevant R&D on preventing lameness in NZ. Much of this work is relevant to Australian conditions.

The approach to extension is discussed above.

### Priorities

- › Review of information available to farmers on track and yard design and maintenance
- › Provision of engineering /design resources to assist farmer decision making on track and yard design and maintenance.





### 5.3. Animal health

Frontline advice and services to farmers are provided by private veterinary practitioners with regulatory services provided by State Departments of Primary Industries. There are standing committee arrangements for coordination of animal health matters that include all State Governments, CSIRO and DAFF.

Peak body and R,D&E services include:

- › Animal Health Australia is an organisation with membership comprised of all the state and Australian governments and the peak animal industry organisations. It has a coordinating role for Emergency Animal Disease (EAD) management and also coordinates activities in nominated areas of endemic diseases eg Johnes disease in all species
- › Universities undertaking research and training
- › Veterinary laboratory services provided by a mixture of state and private organisations and there are national arrangements to coordinate quality control for specific testing regimes.

#### Animal health priorities

- › Closer engagement between dairy industry organisations and DPLs in planning and rehearsing surveillance and control programs for EADs
- › A communication/extension strategy aimed at increasing uptake of Biosecurity practices on dairy farms. This needs to also target advisors, stock agents and other influential individuals to ensure that farmers are getting consistent advice
- › Monitoring vaccination levels for Leptospirosis and Q Fever
- › Encouragement for farmers to be vaccinated for Q Fever and to vaccinate their cattle for Leptospirosis
- › Establish the economic impact of Pestivirus (BVDV) infection in the Australian dairy industry
- › Evaluate the impact of hygienic calf rearing on the occurrence of BJD
- › Implement the Herd Environment Culture test for assessing the BJD status of dairy farms
- › A communication strategy that advises farmers about the causes of recumbent (downer) cows, tools available to assess the likely outcome for individual cases and, if treatment is to be attempted, strategies for humane, effective management of cases
- › Develop a system to get more accurate information about on-farm disease incidence (not limited to animals treated by veterinarians, but rather including all disease incidents treated by dairy farmers as well

as veterinarians on-farm and find out what steps farmers are undertaking to control these diseases) and management

#### Emergency Animal Disease (EAD) Preparedness

Emergency animal diseases such as Foot and Mouth Disease (FMD) and BSE ("Mad cow disease") have the potential to cause devastating effects on the Australian dairy industry and there is a huge investment in surveillance aimed at early detection and a prompt response to any exotic or emerging disease outbreak. The primary responsibility for these activities rests with state departments of primary industries supported by Animal Health Australia.

The Australian dairy industry is very fortunate that many cattle diseases are not present in this country as this saves the costs associated with control and secures markets that would not otherwise be available. The Emergency Animal Disease Response Agreement (EADRA) is a contractual arrangement that brings together the commonwealth, state and territory governments and the livestock industries to collectively and significantly increase Australia's capacity to prepare for, and respond to, Emergency Animal Disease (EAD) incursions. The EADRA is a world-first initiative and Animal Health Australia is its custodian.

The Emergency Animal Disease Response Agreement (EADRA) lists the animal diseases that have been identified as needing an Emergency Animal Disease Response Plan and being eligible for cost sharing arrangements in the event of an outbreak. The Emergency Animal Diseases listed in this agreement are primarily exotic to Australia but can also include specified endemic diseases such as Anthrax under certain conditions such as a major outbreak. The diseases are placed in four categories on the basis of the risk they pose to human health and the severity of the socio-economic disruption to trade if they were to be introduced (exotic diseases) or to cause a major outbreak eg Anthrax. While there are many diseases that are not present in Australia it is considered that the risk assessment issues are generic in that the key activities relate to:

- › disease surveillance to ensure early detection
- › improved sharing of information from surveillance activities
- › the thoroughness of planning to prevent an incursion, and
- › planning to reduce the impact of an outbreak should an exotic disease be introduced.

In considering EADs it is important to remember that there is potential for emerging animal diseases to occur in dairy herds. Such diseases may not previously have been observed or could be a disease that has been described in cattle or other species but, for reasons that are not clear, may begin to spread to cattle herds. There is always the possibility that an emerging disease may also infect people.

### Gaps in Knowledge

- The major EADs of interest to Australia are subject to R&D programs and the Australian Animal Health Laboratory is active in supporting issues of importance to Australia either in collaboration with other countries or in the high security laboratories in Geelong. These projects are aimed at filling knowledge gaps in diagnostic capability and improving understanding of the epidemiology of diseases of interest
- Surveillance. Departments of Primary Industries have primary responsibility for conducting surveillance activities but can only be effective if they are supported by the farming and veterinary communities. At the DMF Workshop for Strategy 3 the view was expressed that there was poor knowledge of the extent of disease in Australian dairy herds and that this was sufficiently serious to, potentially, put the industry at risk. It was acknowledged that there is a substantial level of surveillance undertaken (formally and informally) by different organisations but there is inadequate sharing of information especially with industry bodies. The existing surveillance initiatives are primarily based on disease incidents investigated by veterinarians but there is very little information on the level of disease conditions that are managed by farmers and rarely seen by veterinarians.

### Gaps in Adoption of Animal Health Practices

- Unknown levels of adoption of biosecurity practices.

### Current R,D&E

- Emergency Animal Disease – R&D at Australian Animal Health Laboratory. This work is focused on improving diagnostic tests and devising means to quickly scale up testing if necessary. This work also includes research and development on diseases such as foot and mouth disease in partner countries that are attempting to control or eradicate the disease
- DPI surveillance. The state DPIs undertake a number of surveillance projects including subsidising the cost of veterinary investigations and laboratory testing for unusual outbreaks of disease
- DAFF work with some veterinary practices to monitor the occurrence of animal diseases on client farms. (The Australian veterinary surveillance network)

- Animal Health Australia is also involved with a disease surveillance program including the National Animal Health Information System, National Arbovirus Monitoring Program, the TSE Freedom Assurance Program and the Australian Bovine Tuberculosis Surveillance Project
- Periodic simulation exercises
- Survey of Biosecurity compliance – currently being conducted by Dairy Australia.

### Priorities for R,D&E

#### *Biosecurity*

- Extension strategy for improving adoption of biosecurity measures
- Closer engagement between dairy industry organisations and DPIs in planning and rehearsing surveillance and control programs.
- Develop a system to get more accurate information about on-farm disease incidence (not limited to animals treated by veterinarians, but rather including all disease incidents treated by dairy farmers as well as veterinarians on-farm and find out what steps farmers are undertaking to control these diseases) and management.

#### *Zoonotic disease*

- Monitoring vaccination levels for Leptospirosis and Q Fever.
- Encouragement for farmers to be vaccinated for Q Fever and to vaccinate their cattle for Leptospirosis

#### *Infectious disease*

- A communication/extension strategy aimed at increasing uptake of BJD control measures on dairy farms.

#### *Animal welfare*

- Calf welfare, lameness and downer cows.

### Animal Biosecurity

Management of EAD events is covered by an agreement between the state, territory and Australian governments and the peak industry councils of all the livestock industries. This EADRA agreement focuses, in particular, on managing the cost sharing arrangements in the event of an outbreak of an EAD. Part of the agreement requires the animal industries to be able to demonstrate that their farmers are implementing Biosecurity practices.

The Australian Dairy Farmers organisation has decided that effective management of seven key elements will minimise the risks of introducing infectious diseases, weeds, pests, toxic plants and residues:



- › Managing stock movements.
- › Managing entry and movement of people and vehicles
- › Managing introduction of farm inputs such as stockfeed, water and other inputs
- › Managing risks from adjoining land and neighbours
- › Managing animals to prevent occurrence and spread of disease
- › Prompt and safe removal of dead animals
- › Managing shed effluent and other farm waste
- › Managing contact between wildlife and livestock to prevent the occurrence and spread of disease.

Dairy Australia is currently examining the level of implementation of Biosecurity practices on dairy farms and is planning a strategy to ensure that farmers have access to the best advice on practical ways of assessing and managing their Biosecurity risks.

One of the concepts of Biosecurity is to manage the risks associated with visitors to dairy farms who have the potential to introduce infectious agents and/or weed seeds on their boots, clothing and vehicles. At present, a key element of the extension strategy is to have field days, discussion groups and other events on commercial dairy farms and, in general, no precautions are taken to reduce the risks of introducing disease agents or weeds on to the host farm or for participants to carry home unwelcome passengers. This lack of care (and/or understanding) on the part of organisers needs to be addressed.

#### **Gaps in Knowledge**

- › Understanding of the level of adoption of Biosecurity practices on Australian dairy farms
- › Understanding of motivating factors that encourage farmer adoption of Biosecurity practices.

#### **Current R,D&E**

- › Dairy Australia is currently undertaking a survey to explore the extent of adoption of Biosecurity practices on dairy farms.

#### **Priorities for R,D&E**

- › A communication/extension strategy aimed at increasing uptake of Biosecurity practices on dairy farms. This needs to also target advisors, stock agents and other influential individuals to ensure that farmers are getting consistent advice.

### **Zoonotic disease**

This category of disease includes a number of organisms that have the potential to cause food-borne illness in people. These include Salmonella, Campylobacter, Cryptosporidia, Listeria, Giardia and E.coli. In general, the organisms are killed by pasteurising and dairy products manufactured from pasteurised milk can be regarded as safe if manufacturing, transport and retailing processes are of a sufficiently high standard to prevent post-pasteurisation contamination. Salmonella organisms also produce diarrhoeal diseases in calves and adult cattle and can be a source of infection for farm staff and visitors. Other organisms in this group can be transmitted to people by contact with diseased animals or, in some cases such as Leptospirosis and Q fever, the cattle may appear healthy but be secreting organisms that can infect animal handlers and cause serious disease. Anthrax is also been included in this group of zoonotic diseases because it does have the potential to infect people and, if the infection is not treated promptly and effectively, it can prove fatal.

#### **Gaps in Knowledge**

- › The levels of vaccination of cattle with Leptospirosis and Salmonella vaccines
- › The level of vaccination of the dairy farming community for Q Fever.

#### **Gaps in Adoption of Animal Health Practices**

While the levels of vaccination are not known, it is probably safe to assume that they are less than desirable. It is recognised that the primary responsibility for promoting vaccination rests with the pharmaceutical companies but it is also in the interests of the dairy industry to reduce the occurrence of zoonotic diseases. It is, therefore, in the interests of the dairy industry to monitor vaccination levels and encourage the community to consider vaccination.

#### **Current R,D&E**

- › Vaccine and veterinary therapeutics development by pharmaceutical companies.

#### **Priorities for R,D&E**

- › Monitoring vaccination levels for Leptospirosis and Q Fever
- › Encouragement for farmers to be vaccinated for Q Fever and to vaccinate their cattle for Leptospirosis.

## Infectious diseases

There are a very large number of infectious animal diseases that have the potential to cause productivity losses in the dairy industry. Some of these diseases such as calf scours and pinkeye are relatively common and are managed routinely by farmers. Some of the diseases are routinely prevented by vaccination and others only occur in specific regions. Other diseases such as Bovine Johne's disease (BJD) and Enzootic Bovine Leucosis (EBL) are subject to more regulated control methods because there has been agreement between the industry and state governments that it is desirable to prevent spread of the disease and, in the case of EBL, to strive for eradication from the Australian dairy herd.

### Gaps in Knowledge

- Bovine Johne's disease
  - The effectiveness of implementing the three point calf rearing plan
  - The effectiveness of vaccination for prevention of BJD
  - Farmer attitudes to the importance of taking steps to control and prevent BJD.
- Enzootic Bovine Leucosis
  - The level of EBL infection in beef cattle.
- Bovine Viral Diarrhoea Virus
  - Farmer awareness of ways to minimise the impact of BVDV/Pestivirus infection on their properties.
  - Knowledge of the economic impact of BVDV/Pestivirus infection on Australian dairy farms.

### Gaps in Adoption of Animal Health Practices

- Farmer attitudes to BJD control measures

### Current R,D&E

- Test and Control program – DPI Victoria
- Implementation of herd tests for BJD assurance
- Promotion of the benefits of risk based trading for BJD
- Assessment of the herd environmental test for determining the occurrence of BJD.

### Priorities for R,D&E

- A communication/extension strategy aimed at increasing uptake of BJD control measures on dairy farms.

## Metabolic diseases

These diseases occur when the diet of animals is deficient in one or more essential ingredients or the metabolism of the animal is temporarily changed in a way that precipitates adverse clinical changes or death. In summary the most important metabolic disease are:

- **Milk fever.** This condition occurs frequently in older cows in the peri-parturient period and can lead to sudden collapse and death if untreated. Prompt treatment is usually effective but maintaining vigilance and treating animals can be very time consuming
- **Grass tetany.** Basically, this condition occurs when animals are getting insufficient magnesium. The onset is generally unpredictable and can lead to acute, subacute and chronic forms of the disease. Sudden deaths are often the first sign of the disease. Prompt treatment can be effective and the disease can be prevented by daily supplementation of cows at risk
- **Ketosis.** A general term for a range of disorders that occur in ruminants when they have demands on their resources for glucose and glycogen that cannot be met by their digestive and metabolic activity. Primary ketosis occurs most often in the first month of lactation in well-conditioned cows with high milk yield potential
- **Bloat.** Bloat is a frequent cause of sudden death in animals that have recently been put into a new paddock with a high legume content. Prompt treatment can be successful and the condition can be prevented by the use of slow release rumen capsules or daily dosing with anti-bloating chemicals
- **Acidosis.** The usual cause is considered to be consumption of diets with high levels of rapidly fermentable carbohydrates and low levels of fibre. The extent is unknown but some commentators consider that sub-acute acidosis is widespread
- **Polioencephalomalacia.** Most commonly occurs as a sudden onset of nervous signs in young (6-18 months) cattle that have been fed concentrate feeds under intensive conditions. Parenteral treatment with thiamine is generally effective when delivered early in the course of the disease but it is not clear whether this is a primary thiamine deficiency.

### Gaps in Knowledge

- The occurrence of these diseases
- The adoption levels of preventive measures such as transition feeding
- The ability to predict occurrence of Grass Tetany.

### Current R,D&E

- Development of strategies for transition feeding cows. This topic is included in the Feedbase Program.

## Welfare Issues

The major animal health issue that has the potential to compromise the welfare of dairy cattle is the occurrence and management of recumbent (downer) cows. A report commissioned by Dairy Australia defined the condition as "...cows and heifers unable to stand after 3 hours of recumbency following treatment". This and other reports have noted that between 3 and 5 % of adult cows die each year and many of them would have a period of recumbency before death. The report on downer cows discussed the causes as follows:

*"A rule of thumb would be that 90% of downer cows occur within a week of calving and 90% of downer cows follow the recumbency caused by either milk fever or dystocia. Milk fever occurs mainly in mature cows, dystocia occurs mainly in heifers. The other 10% of downer cows are caused by diseases such as pregnancy toxemia, traumatic injury, grain poisoning and toxic mastitis."*

This report notes that downer cows are sometimes managed in a way that compromises the welfare of the animal and, when the animals are managed in view of the public, they produce a poor image for the industry. For this reason the management of downer cows has been an important focus of the animal welfare program.

### Gaps in Knowledge

- › The effectiveness of preventive strategies for Downer Cows
- › The ability to make an early assessment of the prognosis for Downer Cows.

### Gaps in Adoption of Animal Health Practices

- › Knowledge about the causes of downer cows
- › Information on systems that will allow farmers to quickly assess the prognosis for individual downer cows in order to allow them to assess management options
- › The costs and benefits of management options for downer cows.

### Current R,D&E

- › Dairy Australia and the University of Melbourne are currently designing a proposal that is expected to identify the causes of downer cows in Gippsland and that will provide tools to allow farmers to assess the prognosis of individual cases.

### Priorities for R,D&E

- › A communication strategy that advises farmers about the causes of downer cows, tools available to assess the likely outcome for individual cases and, if treatment is to be attempted, strategies for humane, effective management of cases.

## Human capability

- › It is very difficult to recruit experienced veterinarians to work in rural practice
- › It is also difficult for DPIs to recruit experienced veterinarians to work in rural Australia
- › The majority of veterinarians are not interested in undertaking higher studies in farm animal medicine
- › It has been difficult to persuade veterinarians and some other advisors to adopt a whole farm consultancy approach in preference to (or as an adjunct to) their problem solving mode of operation
- › Farmers are the frontline for management of animal health. They are bombarded with information from retailers and pharmaceutical companies about the importance of different diseases and the merits of different treatment and prevention strategies. The challenge for farmers is to be able to quickly access reliable, independent advice on animal health matters.

### Current R,D&E

- › A project supported by Dairy Australia, the Gardiner Foundation, the University of Melbourne and three Veterinary Practices is currently providing an intern program for three motivated veterinarians who are anticipated to build a career in rural practice
- › Preparation of additional information on animal health to be posted on the Dairy Australia website.

## 5.4. Milk Quality and Milk Harvesting

The scope of milk quality and milk harvesting for Dairy Moving Forward was:

- milk (somatic) cell counts arising from mastitis
- chemical residues in milk associated with mastitis treatments
- microbes in milk associated with mastitis or the process of milk harvesting
- efforts to ensure that labour productivity, cow productivity and farm profitability are not compromised by poorly installed or poorly functioning milk harvesting equipment.

This report provides broad guidance for the dairy industry in the area of milk quality and milk harvesting over a 5-year horizon.

Its content has been based on industry consultations to identify high priority issues (funded by Dairy Australia through Countdown Downunder)<sup>3</sup> and discussions at two Dairy Moving Forward expert group meetings in August 2010.

### Why invest R,D&E in Milk Quality and Milk Harvesting?

- Increasingly, the dairy industry's competitiveness and future success in domestic markets will be underpinned by the need for high quality milk and dairy products. Similarly, the industry's continued access to, and future competitiveness in, our international markets will depend on the supply of top quality milk
- The quality of raw milk at the farm gate sets the ceiling on the quality of liquid milk and dairy products. Put simply, there is no 'fix' beyond the farm gate for poor milk quality
- People productivity at milking time is one of the key factors limiting overall farm productivity. Three quarters of all Australian dairy farmers spend five or more hours a day fetching cows for milking, milking and cleaning up after milking. Milk harvesting represents about 50% of the workload on Australian dairy farms
- A poorly functioning milk harvesting system reduces people productivity at milking time, increases the risk of mastitis and reduces the physical or bacteriological quality of the harvested milk.

Milk quality is important to farm productivity and profitability, and fundamental to the success of the supply chain and the resilience of the dairy industry.

<sup>3</sup> See appendix

Figure 9. Milk quality assumptions across the supply chain



Maintaining milk quality is a complex, multi-factorial, pre-farm gate activity (there is no 'fix' in the manufacturing process.)

Australia's milk quality is a combination of outputs from 7,400 dairy farm businesses. Dairy companies let their supply base know the standard of milk quality they want through individual contracts and milk quality payment schemes. This provides a strong commercial signal, through either incentives or penalties, but not necessarily the capacity to respond (or sufficient 'call to action').

To reduce the risk of mastitis, farms need to have consistent milking routines, optimal milking machine performance, and good hygiene at milking, drying-off and calving every day. Knowing what to do and being able to respond appropriately to changes in circumstances is a lot to ask of dairy farmers. An 'enabling' environment that supports farmers to achieve this (such as having access to dairy service providers, competent staff and good data) requires a collective approach to be achievable and affordable.

If the prize is to protect and improve industry profitability by maintaining milk quality, there will be an ongoing need for joint action and strong leadership in this area. Collective action is needed to develop a good understanding of the commercial environment, decide the major areas of focus, and identify strategic opportunities; as well as providing opportunities to pool resources and attract government support and funding of initiatives.

Table 2. Common topics identified during the 2010 industry consultation

Dairy processing companies (8 companies, > 90% of Australian supply)	Advisers (96)	Farmers (260)
<ul style="list-style-type: none"> <li>• Antibiotic residues in milk associated with mastitis treatments</li> <li>• Unacceptably high levels of thermotolerant bacteria (mainly due to poor cleaning methods, old rubber-ware, poor milking system installation)</li> <li>• Inadequate numbers or skills of local milking machine technicians</li> <li>• Too many herds with chronically high cell counts</li> <li>• Need help with training for their field staff</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of professional milking machine technicians who can install and service milking equipment correctly, find and fix problems competently, and report clearly</li> <li>• Early signs of breakdown in Countdown's clear, consistent messages</li> <li>• Need for on-going training (refresher courses and skills development) for advisers and farmers</li> <li>• Ways of improving staff training and commitment to best practice on farm</li> <li>• Issues about environmental mastitis, and often specifically Strep uberis (how to reduce exposure or deal with endemically infected herds)</li> <li>• Whether the milk pricing signals are helping or hindering action</li> <li>• Unwillingness of many farmers to tackle high cell count issues</li> <li>• Frustration with having to deal with chronically high cell count herds</li> <li>• Time lag and lack of useful results from milk cultures from herds</li> </ul>	<ul style="list-style-type: none"> <li>• Dealing with clinical mastitis—especially questioning treatment effectiveness, concern about the costs (\$ and time) of early detection and treatment, and clinical mastitis at calving</li> <li>• Environmental mastitis and Strep uberis in freshly calved cows</li> <li>• Many concerns about the ability and commitment of staff (especially new workers, casual and relief staff)</li> <li>• Ability to have milking machines operating optimally and access to milking machine technicians willing to do tests</li> <li>• The expense of BMCC control</li> <li>• Lack of experts (in some districts)</li> <li>• Loss of income due to milk quality penalties and low milk price</li> <li>• High Bactoscan/TPC results (and questioning the reliability of factory testing)</li> </ul>

Dairy Australia's Countdown Downunder project is the industry's collective investment in mastitis control and milk quality. Over the past four months Countdown has been involved in an exercise to identify industry issues around mastitis control and milk quality on behalf of Dairy Australia. 380 farmers, service providers, representatives from dairy processing companies and industry gave their opinion of "the 3 most important issues affecting mastitis and milk quality for you and your business, and the industry".

These findings confirm that the Australian dairy industry has a solid story and supporting resources for many of issues raised. However there is an almost universal vacant space where milking machine technicians should be (a situation that has been developing for the last few years); a need for strategies that promote the training and commitment of staff; and a few new technical issues (things industry has not assembled the basic building blocks for such as Strep uberis control and thermotolerants).

The recommendations presented below build on these findings. Fundamentally, ongoing effort is needed to keep the principles and practice of mastitis and milk quality 'front of mind' for farmers and service providers, and making them operational in ways that are relevant to the situations faced on farm.

An ongoing industry steering committee could be given the responsibility to continue to broker a joint approach and regularly review progress and emerging issues. Currently the needs outstrip available funding and it would be worthwhile for industry to seek other opportunities to fund high priority areas.



Figure 10. Milk quality and milk harvesting priorities

R,D&E Themes	R,D&E Activity Areas	R,D&E Outcome
Theme 1: Core resources (D&E)	<ul style="list-style-type: none"> <li>Have Countdown Farm Guidelines downloadable in farmer-friendly sections</li> <li>Enable adviser access to up-to-date supporting tools and resources</li> </ul>	Industry has ready access to best practice & supporting resources
Theme 2: Managing clinical mastitis	<ul style="list-style-type: none"> <li>Develop and deliver strategies to underpin key principles and farm protocols for clinical case management and control</li> </ul>	Dairy herds are implementing clinical case protocols
Theme 3: Managing Bulk Milk Cell Counts	<ul style="list-style-type: none"> <li>Be able to report national milk quality (run the Milk Quality Award)</li> <li>Review the industry's BMCC goals</li> <li>Broker messages that align with the industry goal</li> </ul>	Industry gives clear signals in support of its BMCC goals
Theme 4: Strengthening regional networks and farm services	<ul style="list-style-type: none"> <li>Support a regional 'community of practice' around MQ &amp; MH</li> <li>Coordinate industry response to the need for refresher courses and problem-solving in MQ &amp; MH for service providers</li> </ul>	Regional advisory capacity enables effective implementation
Theme 5: Countdown Cups On Cups Off course	<ul style="list-style-type: none"> <li>Integrate recent research into existing NCDEA course</li> <li>Help recruit participation in the Countdown Cups On Cups Off course (all regions, especially large herds)</li> </ul>	Farms have a consistent milking routine practised by all team members
Theme 6: Efficient and reliable milk harvesting systems	<ul style="list-style-type: none"> <li>Take the lead on workforce development for Milking Machine Technicians</li> <li>Review options for a sustainable training and certification program</li> </ul>	Skilled milking machine technicians are working and staying in the industry
Theme 7: Managing microbes in milk	<ul style="list-style-type: none"> <li>Develop core resources for Australian conditions (based on a review of technical materials)</li> <li>Develop and deliver training on cleaning for field staff and advisers</li> </ul>	Clear, consistent information on control of microbes in milk

## Priority areas for further R,D&E investment

All the elements in this report are regarded by the Dairy Moving Forward expert group as high priority for Australia's capacity to achieve good mastitis control and milk harvesting practices. Work in each area could start as soon as there is the funding and the capacity to do so. A staggered timeline has been offered in the understanding that resources and people's time are finite.

### Theme 1: Core resources

#### Core issue in 2010

Many people on farm are not familiar with the Countdown Downunder Farm Guidelines, which is widely recognized by industry as best practice mastitis control. Only a few service providers have the latest version of tools and resources that support implementation of the guidelines. Industry-agreed guidelines are not available for issues that have surfaced over the last few years (specifically on the cleaning of milking machines and *Strep uberis* control). Some of the technical information written 10 years ago for service providers needs updating.

## Why action this area is important

Having clear, consistent industry-agreed messages and a regional advisory capacity remain the key to effective, economic and sustainable mastitis control and milk harvesting on farm. Consistent messages are necessary for cooperative service provision, and cooperative service provision is necessary for good management. (To put it another way, exchanges are more likely to lead to action if everyone is working from similar principles and beliefs including farmers, factory field officers, vets, milking machine technicians and chemical suppliers.)

The mastitis status of herds is changing continuously. Tools that support good risk management are becoming increasingly important as farmers manage bigger herds and more complexity. Early identification of potential issues can avoid big problems that are costly and worrisome to resolve.

Farmers are exposed to the information principles from Countdown from multiple sources as many practitioners integrate them into their base resources (this can be tested by surfing the net around the various issues relating to mastitis control).

## Current knowledge and capacity

The fundamental principles for mastitis control are well described and have been for years, set out in the Countdown Downunder Farm Guidelines. This booklet has been out of print and out of stock for more than 12 months now (with more than 13,000 copies sold since 1999). Farmers are now most likely to obtain information (printed PDF files) from their service providers. The information is currently being loaded on the Dairy Australia website (according to the style guide of this website which has meant some original design principles, such as guideline numbering and colour-coding by stage of lactation, have been removed).

In the past it has been very difficult to keep track of the mastitis status of a herd; requiring hours, if not days, to collate and analyse herd test, cell count and clinical case information. Countdown Mastitis Focus was launched on the internet in early 2009. It enables tracking of the udder health of herds and exposes gaps in key management areas. Resources have not been available to enable widespread promotion of this powerful tool (other than an initial round of engagement with herd improvement centres and vets in 2009) and it needs to be sufficiently supported to be a stand-alone resource.

## The need

All Australian dairy farmers and service providers should be familiar with, and have ready access to, up-to-date information and tools for mastitis control and milk harvesting practices.

## Recommendations

1. Have Countdown Farm Guidelines accessible to industry including downloadable in print-friendly sections with information presented in a way that is easy for farmers to understand and work with.
2. Package the supporting tools and resources for advisers (such as the Mastitis Investigation Pack, Technotes, Fact Sheets and articles to incorporate in practice newsletters) into an e-toolkit.

(The development of new material on *Strep uberis* control and on cleaning of milking machines is described below in Themes 2 and 7.)

## Timeline

Outcomes within 12 months (by the end of FY10–11).

## Theme 2: Managing clinical mastitis

### Core issues in 2010

A remarkable shift in prevalence of major mastitis pathogens has occurred during the past decade: *Strep uberis* has replaced *Staph aureus* as the dominant pathogen, and *Strep agalactiae* appears to be on the rise again.

Key principles around managing clinical mastitis seem to have been lost over time. Farmer concerns have started defaulting to “getting antibiotics that work” rather than understanding the full gamut of actions necessary to reduce new infection rates and effectively treat clinical cases. From the processors’ point of view, although issues around inhibitory substance are usually minimal they have an enormous impact when they happen (and there has been an increase this year).

### Why action this area is important

Clinical mastitis is a major source of frustration and expense for many Australian dairy farmers. Clinical cases disrupt the milking routine, increase the workload, reduce profitability and introduce a (small but extremely serious) risk of contaminating the vat with antibiotics.

### Current knowledge and capacity

Although there is no way of knowing whether clinical case rates in Australia have changed significantly (less than 10% of farmers have clinical case records available electronically), many farmers (43%) contributing to the recent industry consultation had concerns in this area. Hot topics for them were around treatment effectiveness and the numbers of recurring cases; the cost and time lost in diagnosing and treating clinical cases; levels of mastitis at calving; the increase of environmental mastitis (including *Strep uberis*); and the risks presented by muddy conditions and hotspots (feed pads, calving pads and laneways).

Dairy veterinarians have a good grounding in the principles of clinical case management and are able to help farmers develop protocols and reduce the risk of ‘outbreaks’ in their herd. However they are often not given the opportunity. At the 2010 industry consultation comments were made around the “scattergun approach to treatment” and the need for farm protocols and procedures (“to get farmers to do more than just buy tubes”). And one of the issues for farmers was the extra time it takes for early detection and treatment of clinical mastitis, where the times of high risk (calving, mud etc) place additional onus at a time when demands on the farm team are already high. Concerns about minimizing risks of antibiotic residues seemed to be the province of dairy companies, factory field officers and vets (not farmers).

## The need

Put clinical case management back on the map (making principles 'front of mind') for farm managers and staff. Develop the value proposition for early detection of clinical cases on farm and steps toward reducing new infection rates. Strengthen messages across the supply chain so players better understand the value of their contribution.

## Recommendations

Develop and deliver strategies to underpin key principles and farm protocols for clinical case management. In the first 12 months, develop a clinical case module (Strep uberis Technote and Mastitis Investigation Pack) and deliver to regional service providers to re-energise the networks and reinforce principles of control to dairy farming clients. After 12 months, review ways of strengthening the enabling environment for farmers in this area (eg a continued support of an annual mastitis control symposium for advisers).

Work with dairy companies and Dairy Australia Technical Issues Group to explore ways to develop relationships and communications across the supply chain.

## Timeline

Outcomes within 12 months, then within three years.

## Theme 3: Managing Bulk Milk Cell Counts

### Core issue in 2010

Pricing signals for milk quality are tending to react to immediate circumstances and are sending mixed messages to farmers, increasing the vulnerability of the industry in the medium-term.

### Why action this area is important

Low milk cell counts are an international measure of good milk quality—and one of Australia's main market advantages is its "consistency of quality" (Steve O'Rourke, CEO of Murray Goulburn at Dairy Live in June 2009). Companies pay incentives for premium quality milk because of the advantages of more milk supply, longer shelf-life, ease of plant cleaning and higher cheese yields.

Cell counts in milk are a result of udder infections. Reducing (clinical and subclinical) mastitis infections in herds increases farm profitability: herds produce more milk, have fewer clinical cases to treat and fewer cows culled for mastitis, as well as attracting better milk price payments.

The capacity to produce high quality milk is a significant contributing factor to the sustainable success of farm businesses in Australia. It is difficult to grow a farm business when the job of milking cows is a hassle and the prize (premium quality milk) feels hard to achieve.



## Current knowledge and capacity

All dairy processing companies at the recent consultations said that they would like the cell count of their supply base to be lower. The industry has the capacity in its private service sector to achieve this although many of the service providers (predominately vets) feel unable to convince farmers of the value of taking action.

Furthermore the milk pricing signals of recent years are giving suppliers very mixed messages. For example in 2007 some companies significantly increased milk prices sending a strong signal to market to produce more milk without a proportionate increase in the price paid for premium milk. Many farmers would have chosen to cull cows much later in the season and chase those last few litres at season's end, to the detriment of milk quality. More recently, conditions for "premium" quality have been relaxed in the competition between companies for milk supply (extending to 350,000 cells/mL for some).

Although there are clear benefits to having more suppliers below 250,000 cells/mL the focus of companies in recent months has been on dealing with chronically high cell count herds in a way that satisfies EU requirements (with an audit currently being conducted).

An annual Milk Quality Award has been running in Australia since 2000. As well as publicly recognising herds that consistently achieve good milk quality, the awards provide industry with a bulk milk cell count dataset and national cell count statistic. Having an Australian milk cell count helps processors to 'sign-off' on various export certifications and provides a means for industry to track changes in the udder health of the nation.

## The need

Industry-level messages around the importance of milk quality and the methods to achieve it. A better understanding of the medium-term effect of milk quality payments to help dairy processing companies give signals that support their long-term business interests.

## Recommendations

Continue to run the annual Australian Milk Quality Award.

Broker clear, consistent messages around milk cell counts and explore ways of reporting cell counts that motivate action on farm (within the next 12 months do the research that enables a stakeholder discussion on this).

Develop a 'route to change' for reducing BMCC.

## Timeline

Outcomes of research within 12 months (by the end of FY10-11); start promoting the strategy for reducing BMCC (based on these findings) within 3 years.

## Theme 4: Strengthening regional networks and farm services

### Core issue in 2010

A gradual reduction in investment over the years has meant less industry-led activities in regions supporting the milk quality agenda. The regional networks around mastitis and milk quality that were forged in the early years of Countdown have started to fragment. There are early signs of breakdown in the team approach and access to skilled professionals.

### Why action this area is important

One-on-one interactions between farmers and their advisers are a key driver of change on farms. Regional service providers need to have the capacity to support farmers to take appropriate action for managing risks to udder health and milk quality. Increasing the knowledge and skills of service providers multiplies opportunities for delivery of key messages around mastitis control and risk management to farmers.

### Current knowledge and capacity

The Countdown program had a strong regional presence for its first six years. Service providers in regions had multiple opportunities (regional seminars, training sessions and conferences) to meet other local professionals who advise dairy farmer clients on milk quality and, in many cases, develop a working relationship with them.

Since 2006 project activities have involved piloting of initiatives with targeted groups to assess 'proof of concept' and achieve a 'route to market' rather than resourcing a roll-out across the dairying regions. Similarly training in more recent years has focused on upskilling new entrants to the industry in the principles, practice and team approach to mastitis investigations (through the Countdown Downunder Adviser Short Course offered nationally once a year).

At the 2010 industry consultations advisers were equally concerned about the early signs of the breakdown of Countdown's consistent messages; the need for ongoing education (refresher courses for existing advisers, training for new people entering the industry, and ways of reinforcing the knowledge on farm); difficulties around the provision of control programs to dairy clients; and the need for good information to work from (milking machine tests, mastitis focus reports, herd test reports etc).

The population of service providers is very dynamic with constant changes to peoples' responsibilities, employers, locations and a stream of people entering and exiting the industry. There are now service providers who don't know where to start: where to find tools, how to approach issues and who to talk to in their regions.



Table 3. The changing population of mastitis and milk quality advisers: 2001 compared to 2010

Discipline	Estimate of dairy advisers in 2001 (N, and % Countdown-aligned*)	Estimate of dairy advisers in 2010 (N)
Milking machine technicians	200 (64%)	81–90**
Veterinarians	500 (54%)	558
Other dairy advisers	500 (63%)	147

\* A Countdown-aligned adviser was someone who had participated in Countdown adviser activities

\*\* 81 MMT who receive Countdown correspondence, 90 qualified testers on the AMMTA website

The Countdown Downunder Adviser Short Course (2000 to early 2009) provided a good grounding for new entrants in the principles of mastitis control and an insight into the professional inputs of other disciplines. 16 courses were held over nine years providing training for 175 vets, 105 milking machine technicians and 185 other dairy advisers. A substantial review of the course is now needed with a view to updating the content (incorporating tools such as Mastitis Focus), changing the format (from requiring three experienced trainers on-site) and identifying ways to strengthen regional networks.

### The need

Investment in having a regional advisory capacity continues to be of primary importance to enable dairy farmers to strategically manage mastitis and milk quality.

### Recommendations

Provide regular opportunities for service provider networks to meet (supporting a 'community of practice' around milk quality and milk harvesting).

Training and refresher courses in mastitis investigations and control, and in milk harvesting for new and existing advisers.

### Timeline

Outcomes to re-energise regional networks within 12 months (by the end of FY10–11); then provide regular opportunities to strengthen networks over the next 5 years.

## Theme 5: Countdown Cups On Cups Off course

### Core issue in 2010

Concerns from both farmers and service providers about the ability and commitment of staff to best practice on farm.

### Why action this area is important

For good udder health and milk quality, all operators on the farm (and especially those involved in milking) need to have consistent day-to-day routine aligned with best practice and be paying attention to the details of the farm's standard operating procedures. Having everything that needs to be done getting done is necessary for productive, smoothly running farms.

### Current knowledge and capacity

There have been profound changes in the industry, including the workforce, over the last decade. There are fewer but larger herds (the average herd size increasing substantially from about 170 to more than 260 cows<sup>4</sup>).

About 29,000 people work on Australian dairy farms and the proportion of farms employing people other than family has moved from 30% in 2004 to 70% by 2009. During the past year, 26% of dairy farms recruited staff totalling approximately 3,800 people and approximately 1,700 of these people were new to the industry.

At the 2010 consultation, the top issue for both farmers and advisers in the day-to-day business of producing milk of good quality was the same: staff training and commitment to best practice. This came through in many guises such as concerns when there were changes of staff, having fewer employees to do the work, the ability to motivate people to pay attention to detail, and training of people on farm.

There is already a product on the market that provides training in the fundamental principles of mastitis control and milk harvesting practices for all people who milk cows on dairy farms: that is the Countdown Downunder Cups on Cups off course.



The course has been designed specifically for farm teams (including casual and relief staff) as a way of engendering teamwork, as well as providing a transferable qualification for the individual. This is a high priority for medium to large herds who have more people to get 'on song' and a need to be able to communicate issues between team members. The Dairy Moving Forward expert group believes the course is particularly appropriate for managers and staff who milk large herds to allay some of their issues around mastitis control and milk harvesting.

NCDEA has taken on all aspects of the course administration, marketing and delivery since 2009 and about 20 courses have run in Victoria to date. Some issues need to be worked through to enable more extensive delivery of this course (for example the higher costs of the course in states other than Victoria, and the use of trainers highly experienced in mastitis control on farm).

### The need

To plan and resource a strategy for boosting the demand for Cups On Cups Off courses and to set-up systems that enable the course to run in every dairying region.

### Recommendation

The Dairy Moving Forward expert group believes support to get courses 'off the ground' in all dairying regions would be a sound investment.

### Timeline

Outcomes ASAP within 12 months (by the end of FY10–11).

## Theme 6: Efficient and reliable milk harvesting systems

### Core issue in 2010

Lack of professional milking machine technicians who can install and service milking equipment correctly, find and fix problems competently, and report clearly. This lack will continue to frustrate farmers and will likely reduce both their productivity and profitability.

### Why action this area is important

For the milking system to work at peak efficiency—day-in day-out and month after month—it needs to be installed correctly, to have routine preventive maintenance, to be tested regularly and serviced competently. A poorly functioning system reduces people productivity at milking time, increases the risk of mastitis and reduces the physical or bacteriological quality of the harvested milk.

People productivity at milking time is one of the key factors limiting overall farm productivity. Three quarters of all Australian dairy farmers spend five or more hours a day fetching cows for milking, milking and cleaning up after milking. Milk harvesting represents about 50% of the workload on Australian dairy farms.

### Current knowledge and capacity

Despite the fact that milk harvesting equipment is such a vital part of every dairy farm business, the dairy industry is faced with a severe shortage of skilled technicians to install, commission, test and service milk harvesting equipment. For example:

- › Milking equipment companies report great difficulty in finding reliable dealers and competent milking machine technicians, especially in the more remote dairy regions
- › The prolonged drought has forced many experienced technicians to leave the industry during the past 5 years. An additional reason for the shrinking pool of people is the resources boom which has encouraged competent technicians to leave the dairy industry for higher pay and better working conditions in other industries and states such as WA and Queensland
- › The availability of suitably qualified trainers who can train milking machine technicians is at an all time low. Few individuals have the combined technical and dealership experience required for delivering this specialist training in a credible manner
- › Currently, there are no formal programs for basic training, re-training or formal assessment of technical competencies which are recognized as acceptable by the generic milking harvesting industry in Australia
- › A multi-disciplinary team approach to trouble-shooting mastitis problems in Australian dairy herds has been promoted and encouraged at Adviser Short Courses conducted by Countdown during the past 8 years. The weakest link in the team partnership between veterinarians, dairy factory field staff and milking machine technicians has been the low level of knowledge and competency of many of the technicians and the low quality of information recorded on many of their Test Report Forms.

### The need

Technical training is necessary but costly. It involves specialist hands-on training for small groups of participants. And the current situation cannot be fixed by training alone. If people are to stay in the profession there needs to be a fundamental review of career paths, rewards, recognition and working conditions for technicians, and workforce development in this area.

## Recommendations

The Australian dairy industry needs to develop and implement a 5-year strategy for improving the quality of installation, testing and servicing of milk harvesting equipment. Re-building milk harvesting capacity over the next 5 years should include the following elements:

Establish a workforce development group to review and recommend ways to improve career paths, rewards, and professional recognition for technicians.

Develop a stronger national network between the milking equipment suppliers, AMMTA and other major stakeholders such as Dairy Australia and national programs such as Dairy Moving Forward and Countdown.

Develop a 'pull' strategy targeting the major milk processors, their suppliers and the peak body (Australian Dairy Farmers). The focus would be to create the environment where the accepted practice is to only use technicians who have achieved a certain accreditation – along the lines of the requirements for a licensed electrician or plumber. Clear, consistent messages about the scope and relevance of technical qualifications should be developed so Australian farmers can ensure that the technicians they are using have been trained and assessed adequately.

Have a strong training, assessment and accreditation program that is company/industry relevant, independent and sustainable in the long-term.

Develop quality controls and put a basic complaints procedure in place so farmers can have confidence that the qualifications framework has some real teeth to help maintain standards of testing, installation and service.

Develop formal links to a professional body such as the Plumbing Industry Association or its equivalent for the electrical trades or, preferably, to New Zealand's 'Milking and Pumping Trade Association' (NZ MPTA).

Closer co-operation with NZ appears to be the best way forward, especially when the number of competent technicians continues to shrink. There are significant potential advantages for both countries in having a greater critical mass of technicians and trainers. The fact that all of the major milking equipment companies are active in both the Australian and NZ markets adds further support for this proposed course of action.

## Timeline

Outcomes within 2–5 years.

## Theme 7: Managing microbes in milk

### Core issue in 2010

Major milk processors (covering >90% of Australian farmers) consistently listed high thermophilic counts among their top five priority areas.

### Why action this area is important

Unacceptably high levels thermophilic bacteria in the raw milk supply are associated mainly with factors such as inadequate pre-milking preparation of cows or milking procedures, inadequate cleaning of milking equipment, inappropriate choice of chemicals, old rubber-ware or poor milking system installation.

### Current knowledge and capacity

It seems that many Australian farmers, milking machine installers and chemical sales representatives are not getting the basics right. Furthermore, as milking harvesting systems have become bigger and more complex, factory field officers often don't have the knowledge or the time to pull apart milking equipment in order to track down the source(s) of the hygiene problem.

Good, practical guidelines around the cleaning and maintenance of milking plants, to reduce issues associated with thermophiles, have been developed overseas. However, these guidelines are not widely known or used in Australia.

### The need

Farmers and service providers need access to the core resources to help them troubleshoot problems associated with cleaning systems and practical training in implementing the principles.

### Recommendations

As relevant, practical course materials already exist, the recommendation is to:

- Review technical materials available from relevant training elsewhere, notably from New Zealand MPTA ('Cleaning System Evaluation') and from the UW-MRIL ('Cleaning Systems')
- Review new methods for pinpointing the source(s) of quality problems, streamline the process of finding and fixing hygiene problems in the field, and adapt as required for Australian conditions. (For example 'Cleaning Systems' includes information on strategic sampling.)
- Use the technical materials to develop training field staff and advisers in Australia.

### Timeline

Outcomes within 2–5 years.

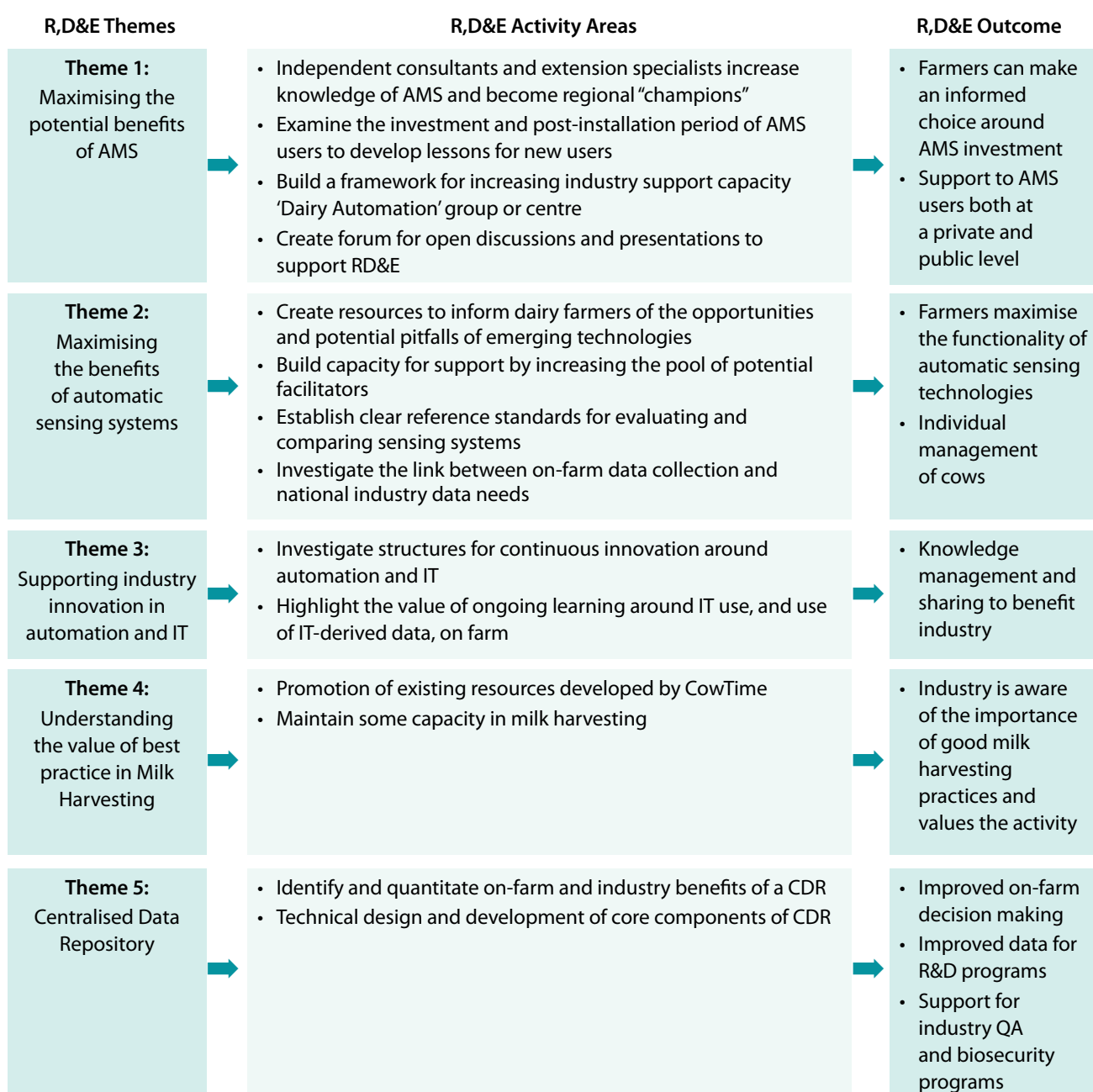
## 6. Strategic Priority Area 4: Investigate novel approaches to improve farm productivity

### 6.1. Overview

Strategic Priority 4 aims to address capability requirements to maximise the potential benefits (and minimise the potential frustration) for Australian farmers who choose to invest in automatic milking and/or new sensing technologies. This chapter addresses industry capabilities required to:

- Improve the efficiency of labour and sustainability of labour by eliminating unnecessary tasks and reducing drudgery
- Monitor individual cow production, weight and body condition
- Detect disease early and accurately to minimise impacts on milk yield and milk quality
- Automate detection of physiological status of animals (eg, g pregnancy, oestrus, anoestrus)
- Alert farmers to the nutritional status of cows through rumen sensing devices
- Provide supporting industry IT infrastructure.

Figure 11. Strategic Priority Area 4 R,D&E themes and industry outcomes



## Desired industry outcome

The seeds of the next global revolution in dairy farming—an automation and information revolution—have been sown in the last 25 years. Many of the tools that will facilitate this new revolution are now available. These include:

- Hardware components of automation which have been developed and improved during the past 25 years such as automatic cluster removers (ACRs), electronic cow identification (EID), electronic milk meters and feeding systems and automatic drafting gates. These components should be viewed as much more than mere items of hardware to save labour during milking. Together, they provide the core elements of an information system for more effective and profitable herd management. The next step in this revolution is to ensure that these tools empower farmers to make incremental improvements in productivity that would be impossible without real-time, accurate data which is integrated and presented to the farmer in a meaningful format.
- Development and improvement of automatic teat cleaning, pre-milking and post-milking disinfection systems, automatic teat location and teatcup application methods in the past 20 years which, together, provide the foundation for the expected rapid uptake of fully automatic milking systems (AMS) in the next 5–10 years.

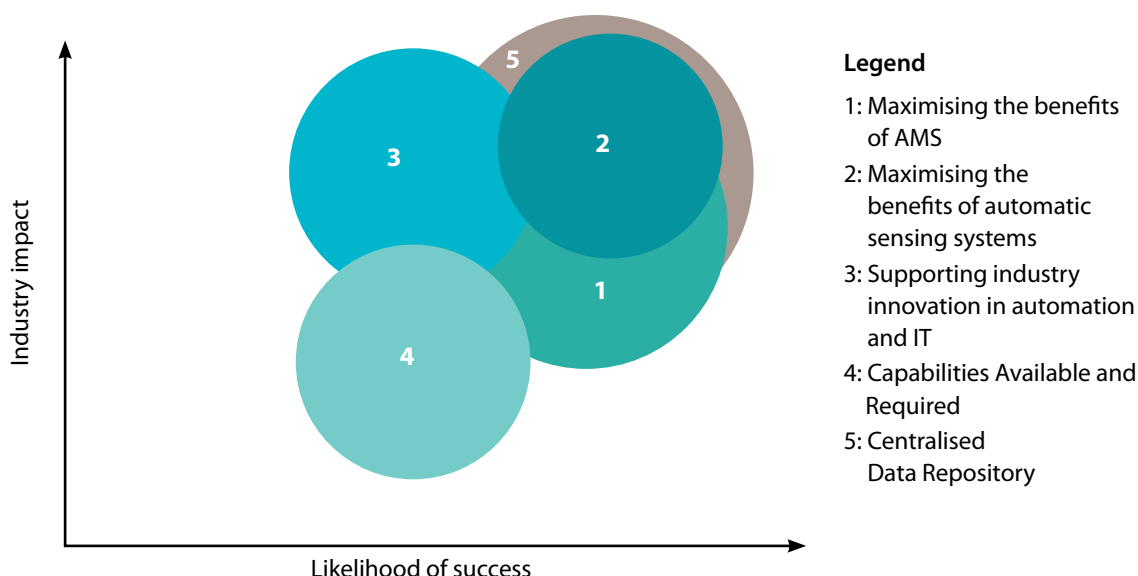
- Development of in-line sensors to monitor milk components, milk quality, mastitis status and the physiological and health status of cows, together with rapid advances in automated interpretation of sensor data (known as 'data-mining').
- Development of a centralised data repository to improve on-farm decision making, support industry R&D programs and provide data support to industry QA and biosecurity programs.

Ideally, these developments will create new possibilities for individual management of cows based on effortless collection and automated interpretation of reliable data.

Although the hardware and software systems exist, and they are continually evolving, integrated training and support structures have not kept pace. The biggest challenge for farmers is to integrate such technologies into their farming system and to manage them to their full potential, thereby ensuring that they achieve maximum benefits from their investment. It is commonplace for commercial companies to sell equipment and, whilst they have an invested interest in ensuring the equipment works, they do not necessarily follow the sale with training to ensure the full benefit of the investment is captured on farm.





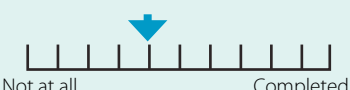
## Impact vs Success

Figure 12. Ranking investment priorities in Priority Area 4 – Industry impact versus likelihood of success (size of the bubble indicates scale of the project)\*



\* Estimations of impact, likelihood and scale of project are qualitative only and reflect the opinion of the Dairy Moving Forward expert working group

## Capabilities available and required

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		Relevant organisations exist with improvements in collaboration possible
Do these people and organisations represent the majority of prior learning in this area?		The majority of learning exists in these organisations however the use/addition of nutritionists or animal physiology experts would assist
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		Benefits from investment are clear as is the case that market failure in these areas also exists
Would the collaborators be able to provide diverse avenues for change?		Current avenues well developed but new avenues would need to be explored to maximise benefits from investments
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		Funding, Infrastructure, and People are limiting factors. Strong industry leadership is required to drive and support initiative

## 6.2. Existing investment activities & key past investments

### Future Dairy project

The Future Dairy project includes exploration of future options for automated milking with particular current emphasis on adaption of automated milking to Australian conditions, viz:

- Automated milking systems provide a platform which lends itself to exploring the value of a number of automated sensing systems for increasing the efficiency of farm management. One of the benefits of an AMS is that the single box system conducts many milkings per day (compared with a cluster or bail in a conventional parlour) so the expensive monitoring or sensing device becomes more affordable by fact that fewer sensors are required (i.e. 160 cows with 2 AMS could install two devices compared with 16 or 32 devices for a 16 aside herringbone dairy that milks the same herd size). Examples of such sensing systems could include:
  - Udder health monitoring including milk yield, conductivity, milk colour, SCC; all down to the quarter level
  - Rumen health/status monitoring
  - Automated weighing and condition scoring
  - The Herd Navigator system for in-line monitoring of some health and physiological states of the cow.
  - Automated oestrus and pregnancy detection tools.
- One of the major challenges is to capture farm management benefits from the vast amount of data that can be generated. This becomes even more complicated when there is a need to link different data streams to provide information that support management decisions
- Data must be trustworthy. For example, cow identification must be reliable and the incidence of lost electronic ID devices must be minimised
- Data must be accurate—it is human nature to quickly learn to ignore alerts or alarms if farmers find that a high proportion of these are false positives. On the flip side if only a proportion of true positive events are recognised the reliance on the data for detection or alerting is rapidly decreased
- AMS systems currently on the market are the conventional box technology. However, a new robotic rotary is in development and the site is expected to be opened to the public in November 2010
- There are currently 12 Australian farms that have installed AMS with an additional 4 farmers (possibly more) who have signed up for installation
- The use of automated systems can change industry practices, eg. automated data capture will reduce the perceived value to farmers for herd test.



## Supporting farmers who choose to invest in AMS

The AMS Integration Project (headed by Sean Kenny and co-funded by DPI and Dairy Australia) is exploring the best options for supporting farmers who have adopted (or are planning to adopt) AMS. The development team is working with representatives from Australia and NZ (including Future Dairy, and DairyNZ) and drawing on information from other countries to build a “knowledge community” that can help identify farms that may be able to benefit from installation of AMS.

## Evaluating the performance of sensing systems

Brian Dela Rue (DairyNZ) is conducting a project on the perceived versus the actual value of commercial sensing systems for detecting clinical mastitis. To date, on-farm evaluation tests of two such systems have been conducted but no results have been released yet. This work is part of a wider 3-year DairyNZ project titled ‘Automation and information technology’ headed by Dr Jenny Jago.

## Herd Testing

Standards NZ is currently conducting a review of NZ’s dairy testing standard. Two key aims are to:

- Increase update of data provided to dairy farmers and instil user confidence in the integrity of the data collected
- Enable the uptake of future technological methods and data collection requirements.

Ideally, Kiwi commonsense will prevail over the proposed new ICAR requirements which include absurdly restrictive limits for accuracy of permanently-installed milk meters and other types of sensors.

## Existing automation systems for conventional dairy systems

A range of automation systems are already available for use by farmers using conventional dairy shed systems. The systems aim to provide some or all of the following:

- Electronic identification of animals in the dairy.
- Controlled feeding of individual animals
- Automatic cup removal
- Automatic teat spraying
- Automatic drafting, automatic weighing
- In-line milk metering (eg, volume, temperature, composite conductivity)
- In-line mastitis measurements
- Identification of animals for milk withholding or treatment
- Animal activity monitoring for heat detection
- Herd Management Information systems.

These systems fall into two categories:

- Systems supplied by international equipment companies (eg Westfalia and DeLaval)
- Locally developed automation systems (eg Jantec, MISTRO, Easy Dairy).

The locally developed systems evolved from the implementation of electronic cattle identification initiated by the Victorian DPI. They were developed as low cost systems focused on identification and feeding, partly because the international versions in early years were perceived as being too expensive.

The existing systems successfully supply basic functionality but are limited in their effectiveness for a range of reasons. These limitations need to be considered as the industry moves towards more technology-based milk harvesting systems.

## Herd Management Information Systems

The user interfaces and data management systems provided by the international solutions suffer from being developed from a year-round calving perspective in countries using very different cattle management systems compared with Australian systems. This often makes it difficult for farmers to get what they need for managing split and seasonal-calving pasture-based herds. In addition, these international solutions often have performance reports that are based on KPI’s which are somewhat foreign to the Australian dairy industry. This makes it difficult to compare farm data with industry benchmarks and thereby identify areas or components where there is room for improvement.

Most solutions focused on the development of a system for the management of a dairy and did not focus on the issue of maintaining accurate data exchange between the farm and industry databases. As a result, farmers who use herd testing are often frustrated by data incompatibility between their own shed systems and industry herd testing systems. Farms that don’t herd test become data islands and don’t contribute to industry databases because much of their data does not comply with industry standards.

## Individual cow identification and feeding

The currently available systems all identify cattle with reasonable accuracy and can implement a range of individual cow feeding options. However, systems installers have very limited knowledge about the feeding of cattle. Furthermore, the level of training provided to farmers, on how their systems may be used to improve and manage feeding on farms, is very limited. A few farmers have developed a strong grasp on how to manage their systems to manage the feeding

of individual animals. However, a lack of appropriate support on many farms results in the feeding system being under-utilised. Education on how to fully utilise individual cow feeding in future developments should be a priority. In addition, these feeding systems generally do not account for the marginal value of milk or allow the farmer to incorporate the cost of feed into the automated management decision process.

### **Automated teat spraying**

A number of systems have been developed for automatic teat spraying either in the dairy or in the exit race. None of these have been rigorously tested to ensure their effectiveness and, in many cases, they do not achieve basic coverage of all four teats. Some probably work as well as the alternative human sprayers but, in many cases, automation is not achieving the desired result. A review of the design and effectiveness of automatic teat spraying systems would be appropriate in designing future technologies.

### **In-line milk volume metering**

A number of systems have the capacity to measure and record the volume of milk produced at each milking. In most cases, these data are used to reduce the need for conventional herd testing. In some situations, automated feed levels may be adjusted according to measurements from the milk meters. Limited use of these data is made within the industry to accurately identify sick cows and to manage automated feeding. In many cases, maintenance of meters is so poor that farmers lose faith in the accuracy of the devices to assist them with feed or animal management.

### **In-line mastitis measurement**

Milk metering/sensing systems are also capable of measuring other features of milk produced such as temperature and conductivity and, in some cases,

indications of fat/protein ratios and somatic cell counts. These variables have been advocated as a means of monitoring mastitis and animal health but no protocols have been developed describing how they may be used, accurately and reliably, for these tasks.

Early adoption of in-line mastitis measurement has had mixed results which may slow the adoption of future more accurate systems. Experience in Australia highlights the importance of developing fully integrated systems that can be demonstrated to improve farm management and performance. Industry may be required to fund the studies needed to document accuracy and develop recommendations on the use of some new technologies on-farm so that effective integrated systems may be demonstrated to improve uptake. Obviously, this is a sensitive area because the use of industry money to test and develop recommendations around commercial products is often frowned upon. Furthermore, investment in the testing of one product but not another can be difficult to justify. For the longer term, however, if industry progress could be improved by maintaining farmer faith and trust in new technologies, then such a process may well be worthwhile.

### **Detecting oestrus using activity monitoring devices**

A few systems provide options for measuring the daily activity of cattle as an aid to detection of oestrus. However, the cost of these systems has been a major barrier to their rate of uptake. The automated and accurate detection of oestrus cows should be a high priority for the Australian dairy industry. Activity monitoring and other technologies in this area should be reviewed to determine their potential effectiveness. In this context, the Herd Navigator system is reported to be creating worthwhile improvements in reproductive performance overseas. This device would be worthwhile investigating as it would have application in both conventional and automatic milk harvesting systems.



### 6.3. Important industry R,D&E needs

The following comments, from three experienced farm advisers, highlight critical shortcomings in the current application of sensing technologies:

*'People have blind faith in some of these systems, without proper training it's almost a waste having them there.'*

*'19 out of 20 farmers have no idea how to use their automated system and what to get out of it.'*

*'Maintenance is also an issue. I see farms with systems that are not being used because no one has been able to keep them working properly.'*

#### Competent support for farmers who are considering AMS

- It is essential to consider the whole farming system before investing in AMS. If a farmer happens to be a poor pasture manager, installing sophisticated milk harvesting equipment is not likely to create the increased profitability that is required for the farmer to remain sustainable through challenging periods (e.g. periods of low milk prices, periods of increased cost of bought-in feed). At this stage we don't understand enough about the impact of pasture management on AMS farm productivity, especially given that feed is the biggest and most reliable incentive for maintaining good cow traffic. Thus, poor pasture managers may be unsuccessful as adopters of AMS because the system simply cannot tolerate low levels of accuracy in pasture allocation, due to the negative impact on cow traffic.
- The development of AMS is still at an early stage and the future of the technology is vulnerable to industry perceptions of the value of the technology and failure of an installation could undermine confidence.
- Market failure. Although manufacturers of AMS are keen to sell units and, therefore, are prepared to provide initial training and servicing of machines, it is clear that farmers will require advice and support in addition to that provided by manufacturers. The manufacturers/distributors are the obvious suppliers of technical support (keeping the machines milking cows). Manufacturers are also starting to recognise that farmers need support in other areas of farm system management in this new way of farming. However, farmers are generally reluctant to pay for this support and the manufacturers may not necessarily envisage enough future return on the business to provide such a service at no cost. The Expert Group believes that the potential benefits of automated technologies are so great that there is a strong argument for public/industry support during the vulnerable period until there are sufficient installations to support private service providers.

#### Competent support for the majority of farmers who milk in conventional systems

Because most farmers will continue to milk their herds in conventional rotary or herringbone milking systems during the next 10 years, it is important not to focus exclusively on AMS. These so-called 'conventional' farmers will be bombarded by information on different levels of automation and it is important that they have the resources to make informed decisions about what is likely to be appropriate for their farming system. In particular:

- The data generated must be reliable because trust can be lost very quickly, eg. by having too many false positive results that generate unnecessary work, confusion and frustration.
- Adoption of automated technologies requires development of sophisticated software and increasing the skills of farmers.

### 6.4. Current capability and gaps in knowledge

Many of the technologies are developed in other countries and there is a need to adapt them for use in Australian conditions. This includes technical (both hardware and software) design issues and training for people purchasing (or contemplating purchase) of the equipment. There is also a need to plan how the wide range of technologies can be combined into a worthwhile system for individual farms. These new technologies are likely to offer farmers the essential tools to achieve the productivity gains that are required for the Australian dairy industry to remain sustainable and competitive. If farmers cannot capture the full benefits of these technologies, then the potential for industry sustainability and competitiveness will be eroded.

The lack of support provided for current installations of automated systems needs to be addressed in the rollout of future technologies. For example:

- A number of local systems have been developed by small single-person operations and this business model is not a sustainable solution for providing systems that are supported in the long term.
- Few people within the Australian industry have the skills necessary to service and maintain these systems, thereby making them vulnerable following installation.
- Because specialist skills are required for the maintenance of each of the automation systems, each supplier requires its own support technicians.
- Installations are spread thinly over large geographic areas making on-site service difficult and expensive to provide.

The importance of ongoing system maintenance, combined with the high turn-over of staff on some farms, dictates the need for long term support and service. This is often lacking following the initial installation of the system. Companies can earn their margins from the initial installation but the provision of high quality support following installation is extremely difficult to provide and maintain on a cost-effective basis.

A lack of service (and hardware and software upgrades) has often resulted in systems being run down and outdated and only used to complete the most basic options rather than fully exploiting their long term potential. This experience suggests that it would be best to roll out future technology advances within a small number of systems so that it is possible to provide an effective long term support network for their use. The training of support technicians and the provision of long term support for automation systems may require industry support to fully capture the benefits of the technology. High-impact technologies may also benefit from incorporation of technology-specific training within institutions such as NCDEA to ensure that new recruits entering the industry as farm employees are well informed in the capability and potential impact of some technologies. Such training would encourage full utilisation on farm while also enhancing the value of individuals (as recruits) to the farmer.

There is a need for independent advice but it is not clear who will be the supplier/s. The number of advisers with milk harvesting expertise, especially in states other than Victoria, is very limited. There is an urgent need for training at both technical and post-graduate levels to ensure that competent advisers are available to help farmers negotiate the coming revolution.

Active “succession planning” is essential to create a pool of competent advisers who can provide the type of independent advice and guidance that dairy farmers will need (or demand?) to help them navigate the automation/information revolution and to better understand the perceived mysteries of increasingly complex milk harvesting systems.

## 6.5. Priority areas for further R,D&E investment

(See summary table in Appendix 3)

To maximise the benefits of the Automation and Information revolution, a ‘Dairy Automation’ group or centre should be established. This initiative could encompass all four of the themes outlined below. Preferably, this centre would be a virtual network of interested experts from Australia and NZ (and, perhaps, from outside of Australasia?), rather than a ‘bricks and mortar’ establishment at a single site. A co-ordinator (or core team) could be based at a single site (e.g. Camden, NSW or Hamilton, NZ) and could operate under the general umbrella of the Future Dairy (Camden) program or within DairyNZ. This team could be co-funded by Australia and NZ to increase the impact of the investment in such a group.

The primary functions of a Dairy Automation Group could include all or some of the following:

- To provide on-going independent, expert advice to industry on priorities for R, D and E.
- To determine the appropriate private/public roles for AMS support structures.
- To identify new technologies that may be applied in Australia for the benefit of Australian dairy farmers (ie, What could we do?).
- To initiate and co-ordinate relevant studies to document the effectiveness of new technologies under Australian conditions (ie, Which ones work?).
- To recommend to the Australian Industry the most appropriate technologies for adoption and to oversee the demonstration of these technologies on demonstration farms (ie, How do you make them work on farm?).
- To provide a resource for farmers and industry organisations around dairy automation investment decisions and principles for on-farm adaptation.
- To guide the development of specialist training opportunities, thereby increasing the pool of potential advisers and ‘facilitators’.
- To promote and oversee the creation of post-graduate research opportunities on relevant topics.

Selected new technologies could be fully incorporated into regionally-based demonstration systems (eg, at the Macalister Demonstration Farm or the Western Vic Demo Dairy) and used to show how the technology can be used to improve management and provide educational materials on installation and use.



Alternatively, or in addition, milk harvesting systems owned by commercial farmers could be utilised to test new technologies. While this option would be more difficult to co-ordinate, and may require the provision of some funding for the farmers to facilitate the process, it would certainly be cheaper. Usually, the scale of data collection required for the specific investigation determines the “best” approach (i.e. commercial or research herd). Less detailed but large datasets are generally easier to access on commercial farms whilst detailed and intensive investigations with smaller sample sizes are generally more suited to research/demonstration farm facilities.

The main aim would be to have a group of people dedicated to the task and provided with long-term funding and support to ensure capabilities are developed and maintained and that necessary research can be carried out in timely and cost-effective manner.

## **Theme 1. Maximising the potential benefits of AMS**

### **Core industry issue**

AMS is radically different from dairy farming as we have known it. The current adoption rate (even under recent burdens of drought and poor milk prices) is very promising and further encouragement is associated with the recent media release of an Automatic Milking Rotary (AMR). Application of AMS in Australian dairy systems will present significant challenges for farmers. Currently, our industry is ill-equipped to help farmers through the transition. Investment in R&D around AMS, together with easy access to independent and informed advice and industry-wide support capability, is required to head off potential market failure.

### **Proposed activities**

Ensure that farmers have sufficient knowledge and access to independent advice to understand the true impact that AMS is likely to have on their business. This initiative should ensure that any economic evaluations are a true reflection of the outcomes expected for the individual businesses and also that each farmer has a realistic expectation of the impact the technology will have on them, their staff, cows and business. This can be achieved through knowledge generated via research, development and in association with existing commercial AMS farms.

Such knowledge can then be delivered to the people at the front-line—i.e. the extension specialists, educators, industry representatives and consultants.

Understand how AMS can be incorporated successfully into a wide range of farm systems through research, interviews and case studies. Success will be defined as achieving target milk production, feed utilisation, and reduced environmental impact, all with a high level of profitability. This will be carried out by continuing research into AMS farm systems. It will also involve increased association with commercial AMS farms to understand the challenges they face and the approaches taken to develop specific solutions.

Investigate models for support of AMS farmers in the three stages of uptake (pre-farm decision making, on-farm decision making, post-installation decision making) and explore/develop training packages for facilitators and technicians who can support the new technology in the field. The goal is to ensure that a network of capable support personnel at the coal-face is available to help farmers through the challenges during the commissioning and post-commissioning periods. As an industry, we provide a multitude of free services to farmers to ensure that they have the best chance of being viable, sustainable and successful (regardless of their farming system). Of course, farmers can source user-pays advice from private consultants as well. However, this is most common for one-on-one advice in areas that are otherwise serviced through commercial avenues (e.g. a farmer may choose to pay for a private nutritional consultant rather than use the free advice of a nutritionist associated with a feed company). As an industry, we should have “champions” trained as AMS experts to consult, extend and assist AMS farmers throughout all regions. These champions would be experts primarily in the area of farm management rather than the technology itself.

Ensure that knowledge generated through research and on-farm application in the area of data interpretation and technology application are fed back to the commercial companies to create the best opportunity for their support software to integrate reports and monitoring applications that best suit Australian farming systems. This needs to be done through a co-ordinated regular meeting of the commercial suppliers of AMS with research and extension champions. This may best be conducted (during the next ~5 years) through an annual workshop/symposium involving commercial suppliers, farmers, researchers and extension specialists. Ideally, such a forum will help to create an atmosphere in which farmers freely admit areas in which they are struggling or are still searching for solutions. It would ensure that researchers are familiar with the true on-farm challenges and would help the manufacturers to understand the needs in capability and functionality of the equipment for Australian farming systems.



Conduct an annual AMS or AMS/technology symposium whereby industry knowledge can be disseminated. This would likely involve farmer, research and extension presentations. This may not necessarily be a physical gathering of people but may be a virtual symposium whereby the proceedings are conducted online. Before such a decision is made, the success (or otherwise) of other virtual forums that have been conducted in the recent past (e.g. DairyLive) should be reviewed.

### Outcomes

- › An industry that is in the best position to create the opportunity for farmers to encompass the benefits of the AMS on farm.
- › An industry that can provide farmers with the knowledge and advice required to make an educated decision regarding investment in AMS. Adopting such a technology for the wrong reasons or with the wrong expectations has the potential to be very damaging to the individual and to the rate of adoption within the industry.
- › An industry that can support farmers that have taken the decision to adopt AMS to ensure that they are positioned to truly capture the benefits of the technology.
- › Farmers who are successful in their new way of farming, and positioned to be most sustainable and competitive.
- › Knowledge generated on farm and through research is captured and put in a format that is easily accessible and disseminated to industry champions thereby resulting in rapid industry level advancement in on-farm application of AMS.

## Theme 2. Maximising the benefits of automatic sensing systems

### Core industry issue

Use of automatic sensing systems on dairy farms is expanding, but farmers and retailers are often operating in isolation when they install and use these tools. The potential benefits of such systems are sometimes oversold during the sale process, and the early use period provides many challenges for farmers due to technical teething issues and management adaptation. Currently there is a lack of industry investment in this area, to fill the gaps left by the private sector. This theme is aimed at addressing these issues at an industry level, in conjunction with Theme 3.

### Proposed activities

- › Create resources to inform dairy farmers of the opportunities and potential pitfalls of these technologies. Currently, the primary information available to farmers around the automation and IT investment decision is provided by retailers and other farmers. Balanced and informed information about the benefits of these technologies, and guidance on the impact on farm management practices, will provide an important resource.
- › Build industry capacity for support of automation and IT. Retailers currently provide training to their clients but are limited by financial resources, location and availability of appropriately skilled trainers. There is a role for consultants and industry extension personnel to provide advice and training for farmers after the initial installation period.
- › Investigate the link between on-farm data collection and national industry data needs. With the expanding use of data collection devices on-farm there is a growing pool of data which may have value to the wider industry for herd improvement or strategic decision-making. However, a real incentive needs to be provided to farmers before they will make data transfer a routine feature of their farming practice. This incentive may be in the form of benchmarking information, or actual payments for data that the industry needs and values.
- › Clarify and promote agreed guidelines on practical reference standards against which new sensing systems can be evaluated. As an example, it is almost impossible to decide what are the 'right' performance measures by which different mastitis sensors can be judged or compared, because of the present plethora of 'true' gold standards for abnormal milk, clinical mastitis and subclinical mastitis.
- › Review current automated technologies available for detecting cows requiring mastitis treatment and document the results for industry. The methods required for successfully implementing the appropriate technologies on farm should be identified so that these methods are incorporated within the herd management systems managing the dairy.
- › Identify the data collected by the automation systems currently available to farmers. Investigate data mining and develop recommendations on how data should be used in the whole farm management system. For example:
  - How should individual cow feeding be managed?
  - How can daily milk values be used to enhance management decisions?

## Outcomes

- › Farmers are able to maximise the functionality of automatic sensing technologies in their particular system context.
- › There is a real incentive for farmers to share on-farm data with the wider industry.

## Theme 3. Milk Harvesting

### Core industry issue

The importance and value of best practice in milk harvesting has fallen off the radar in the last decade due to the many challenges that have confronted the industry in that time. The continued push for efficiency and the challenge of low milk prices and lack of water have been some of the issues that make survival the main game for many.

Milk harvesting is important in AMS as well as conventional milking systems. AMS is challenging our understanding of the herd mentality. Cows are showing they will move more independently than was commonly thought in AMS. Still animals need to be handled and treated in all systems so the skill and understanding is important in all systems.

It will be many years before the proportion of farms harvesting milk through some form of AMS exceed the proportion using conventional milk harvesting equipment. To make the best use of any system there are certain basic design principles to ensure it is both cow and human friendly. Many dairies are still being constructed with some poor designs that impact negatively on labour requirements and efficiency, cow flow and even in some cases animal welfare.

### Proposed activities

- › Trainers in the NCDEA system need targeted training in the milk harvesting area. If the main delivery vehicle is to be the NCDEA then the staff should be a standard for the industry. That is not yet achieved.
- › While AMS may make milking a background activity, a comprehensive understanding of all aspects of the process is essential to allow for system throughput and utilisation to be optimised. It will require attention and the skills to make the most of any milking system.

## Theme 4. Supporting industry innovation in automation and IT

### Core industry issue

Significant innovation occurs after automation and IT are installed on farm, and it is the farmer who is the driver of these innovations. Currently some of the lessons that farmers learn, and the adaptations they make or seek to make, are captured by the technology retailer and incorporated into new versions of the technology. However this innovation loop is hampered by product development timelines and the commercial imperatives of proprietary systems.

### Proposed activities

- › Investigate structures for continuous innovation around automation and IT. Design a program of work to facilitate an innovation network around current and potential members of the automation and IT community.
- › Highlight the value of ongoing learning around IT use, and use of IT-derived data, on farm. Currently, farmer learning of IT is often limited to a brief initial training period provided by retailers followed by experiential on-farm learning. With IT use becoming an increasingly important feature of future dairy systems, there is a need for farmers to recognise the value of training in IT. It must be viewed as a valued commodity rather than expecting ongoing free training from technology providers.

### Outcomes

- › Knowledge created by farmers is captured and made available to the wider dairy industry, thereby increasing the value achieved from automation investments.
- › Farmers place a value on IT learning as a key function of their business performance.

## Theme 5. Centralised Data Repository (CDR)

### Context

There is widespread acceptance of the fact that Australia does not have a coherent approach to the collection, use, transfer and access of dairy data and that this is limiting productivity gains in the dairy industry currently and will continue to do so in the future.

A Working Group initiated by NHIA has been active since January 2009 in consulting widely within the dairy industry to build a consensus towards a shared vision of how dairy data in Australia can be improved. This process has resulted in the publication of a comprehensive report by the consultancy firm, GHD, which was released in August 2010 (A summary of this NHIA report can be found in the Appendix 3).

The report highlighted four possible scenarios for dairy data in the future.

1. **Laissez faire**—market drives rationalisation and increasing demand for better information products from herd data.
2. **Standards Drive Approach**—focus on standardisation and data flow.
3. **Centralised Data Repository**—builds on Scenario 2 by establishing a pre-competitive herd testing/data approach through the development of a national Data Repository.
4. **Full Integration**—builds on Scenario 3 by establishing a single unified data architecture and software system.

The scenarios are designed to build on each other in a structure that supports progressive discovery so that the industry can investigate, check, decide and then act. The consultant's report recommended Scenario 3 (Centralised Data Repository) which calls for the establishment of a centralised, industry-owned, repository where quality-assured data from all sources are accessible for industry-wide use.

The Working Group invited feedback on the report from a wide cross-section of industry and of the survey replies received, 60% indicated that they agreed with Scenario 3 (Centralised Data Repository) being the recommended scenario. The next most supported was Scenario 4 (Full Integration) at 20% of respondents. Significantly, 75% of respondents to the survey on the report said that Scenario 1 (Laissez Faire) in which no action is taken to improve on current data arrangements was the least-preferred option—in other words, doing nothing to improve the current situation is not seen as a viable option.

The current situation facing dairy data is complex, involving multiple drivers, stakeholders and data value chains and improvements will require a systematic rather than a singular approach. The time has come for Australia to invest in setting up a dairy data system that better serves the needs of farmers as well as the wider industry, in providing the means to make more informed decisions based on factual data.

### Key Benefits of Improved Dairy Data

The GHD Consultant report strongly made the point that an accurate Benefit Cost Analysis (BCA) of the four scenarios is very difficult to derive based on current frameworks and information:

*"The lack of quantitative analysis of both the benefits and costs relating to improved data management/use and the impact on farm level decision making and performance is a significant gap for the Australian dairy industry." (Appendix F)*

Nevertheless, after consulting with ABARE, Dairy Australia, ADHIS and others, the consultants estimated that Australia could achieve gains of between \$10–\$50 million during the next 10 years if farm level data management could be improved. The Working Group believes that a more accurate financial estimate of the potential benefit for improving data is both necessary and possible. These estimates are key data points in the "investigate, check, decide and then act" approach outlined in the GHD report.

There are, however, a number of clear benefits that improving data would bring to both farmers and industry as a whole, including:

- › Improved decision making on-farm mostly associated with milk quality and cell counts, nutrition, reproductive performance and sale/culling of animals. A 1997 ABARE report "Herd recording's economic contribution to the Victorian dairy industry" cites a net value of \$16.3 million in 1993–94. This figure is likely to be substantially higher in 2010
- › Improved accuracy of Australian Breeding Values (ABVs) which enable farmers to select AI Sires which maximize genetic gain and therefore profit. In his 2005 "R&D Plan for dairy cattle genetic improvement" Professor Mike Goddard cites a 10% increase in the rate of genetic gain having a net present value of \$20 million
- › Improved cow fertility data through increased recording of mating and pregnancy testing data which will enable scientists to formulate more effective indices to measure and select for fertility
- › Single entry/multiple use data entry recording which will simplify record-keeping for farmers, reduce errors and make dairy farming easier
- › Deliver greater access and benefit to dairy farmers from established industry program investments such as InCalf (Fertility Focus Reports) and Countdown Downunder (Mastitis Focus Reports) which cannot be delivered without quality data
- › Improved predictions of future milk flow to milk buyers and processors thereby increasing efficiency of processing plants
- › A centralised and therefore more effective system of Quality Assurance (QA) data will reduce the costs of auditing and compliance and enhance Australia's reputation as an exporter of quality milk products
- › Such a centralised repository will strengthen the ability of authorities to effectively monitor livestock disease threats and animal welfare issues which will enhance biosecurity within the dairy industry
- › Provide a single, rich source of data for future use by scientists and researchers.

## Centralised Data Repository (CDR)—recommended scenario

The establishment of a CDR is recommended by the Working Group because it has the most realistic prospect of succeeding in terms of managing existing stakeholders and current industry structure/competition as well as stakeholders' ability and willingness to change. The CDR envisaged by Scenario 3 is considered to be aspirational but still cognizant of commercial reality and supportive of future innovation.

Although Scenario 4 (Full Integration) has possibly a higher potential for Net Present Value according to the GHD report and subsequent feedback received, the Working Group is of the view that this option is not politically achievable at this time.

The CDR requires the establishment of three components: National Data Network, Data Repository and Extension Services. This recommended scenario is considerably more than enhancement of the current system because it requires equity, participation and commitment from all stakeholders to be effective. A staged approach which progressively designs, tests and implements the components is proposed.

In the long term, the CDR should aim to consolidate data from the following sources:

- Herd improvement centers/Data Processing Centers (DPCs)
- Farm software systems
- ADHIS
- Breed Societies
- Milk factory BMCC and milk quality results
- Milk factory QA program results
- NLIS farm and animal identification
- DFSV (and similar organizations in other states) farm identification data
- Records of animal disease and test results (e.g. pregnancy tests) collected by veterinarians.

## Necessary Steps for Implementation of a Centralised Data Repository

The GHD Consultant's report provides a comprehensive blueprint for the creation of a CDR.

Two precursor tasks will be to finalise the composition of an expanded Working Group to provide leadership and drive the project forward and to more clearly define the economic benefits of improving data.

There are then two immediate key tasks:

- Source funding to commence designing and developing a business model that outlines the commercial foundations of the CDR including:
  - Governance arrangements
  - Business model and strategic plan, including improved BCA of project
  - Cost estimates for core elements
  - Potential sources of finance.
- Source funding to commence technical design and development of core components of CDR (National Data Network, Data Repository and Extension Service) as well as focus on standardization and rationalization of data flow.

## Conclusion

There is no single organization currently in existence in the Australian dairy industry that has the capacity to implement a Centralised Data Repository.

The achievement of this goal will require the co-operation and collaboration of all sectors of the dairy industry including peak industry bodies, Government, dairy farmer representatives, milk buyers/processors and service providers.

The lack of a coherent system for the collection, transfer and access of dairy data is a major issue for the Australian dairy industry.

The publication of the "Report for NHIA Dairy Industry Data Project" is the first step towards a solution and the Working Group hopes to build on the momentum that has been gathered in the past eighteen months.

## Appendix

### Appendix 1—Breeding herds that perform in Australian conditions

#### 1. Improving the rate of genetic gain for Profit

##### Increasing the genetic merit of the national herd for profit and ease of management

Improved science of genetic evaluation	To simplify the messages around breeding
<b>Objectives</b> <ul style="list-style-type: none"> <li>To increased rate of genetic gain for profit</li> <li>To implement new genetic models for traits deemed important</li> </ul>	<b>Objectives</b> <ul style="list-style-type: none"> <li>To ensure genetics is seen as a direct contributor to profit</li> <li>To provide clear information and services to farmers around breeding decisions based on farmers desired breeding objective</li> <li>To provide value added services to AB companies and service providers</li> </ul>
<b>Expected Outcomes</b> <ul style="list-style-type: none"> <li>Increased reliability of ABVs</li> <li>Increased on-farm profit from genetics</li> <li>Increased genetic gain for desired traits</li> </ul>	<b>Expected Outcomes</b> <ul style="list-style-type: none"> <li>Greater use of ABVs (high ranked sires)</li> <li>Improved confidence in breeding decisions</li> <li>Independence of information valued</li> </ul>
<b>Who should be involved</b> <ul style="list-style-type: none"> <li>ADHIS CRC</li> <li>DPIV</li> <li>Dairy Australia</li> </ul>	<b>Who should be involved</b> <ul style="list-style-type: none"> <li>ADHIS</li> <li>DPIV</li> <li>Dairy Australia</li> </ul>

#### 2. Improving fertility

##### Ability to get cows in calf soon after their mating date

Better Knowledge of National Reproduction	Improved Understanding of Causes of Reproductive Perf
<b>Objectives</b> <ul style="list-style-type: none"> <li>Increase the amount and quality of data collected from more herds</li> <li>Incorporation of preg test data</li> </ul>	<b>Objectives</b> <ul style="list-style-type: none"> <li>Define causes (known and unknown)</li> <li>Define relative importance of causes</li> </ul>
<b>Expected Outcomes</b> <ul style="list-style-type: none"> <li>Ability to more accurately measure drivers of fertility</li> <li>Ability to more accurately measure change over time</li> <li>Farmers having a better sense of reproductive performance</li> <li>More targeted investment in reproductive performance</li> </ul>	<b>Expected Outcomes</b> <ul style="list-style-type: none"> <li>Farmers re-focus on key reproduction strategies under their control</li> <li>Farmer clarity around causes</li> <li>Improved confidence to increase reproduction</li> <li>More targeted industry investment in reproductive performance</li> </ul>
<b>Who should be involved</b> <ul style="list-style-type: none"> <li>InCalf</li> <li>Vets (Preg Testers)</li> <li>ADHIS</li> <li>Herd Recording Centres</li> <li>Herd Management software providers</li> </ul>	<b>Who should be involved</b> <ul style="list-style-type: none"> <li>InCalf</li> <li>Nutritional Researchers</li> <li>Universities / Government</li> <li>ADHIS</li> </ul>



## Improved Industry data to support on-going R,D&E

Improving the amount of good quality industry data and research data answer key questions about animal system limitations and enable better genetic selection.

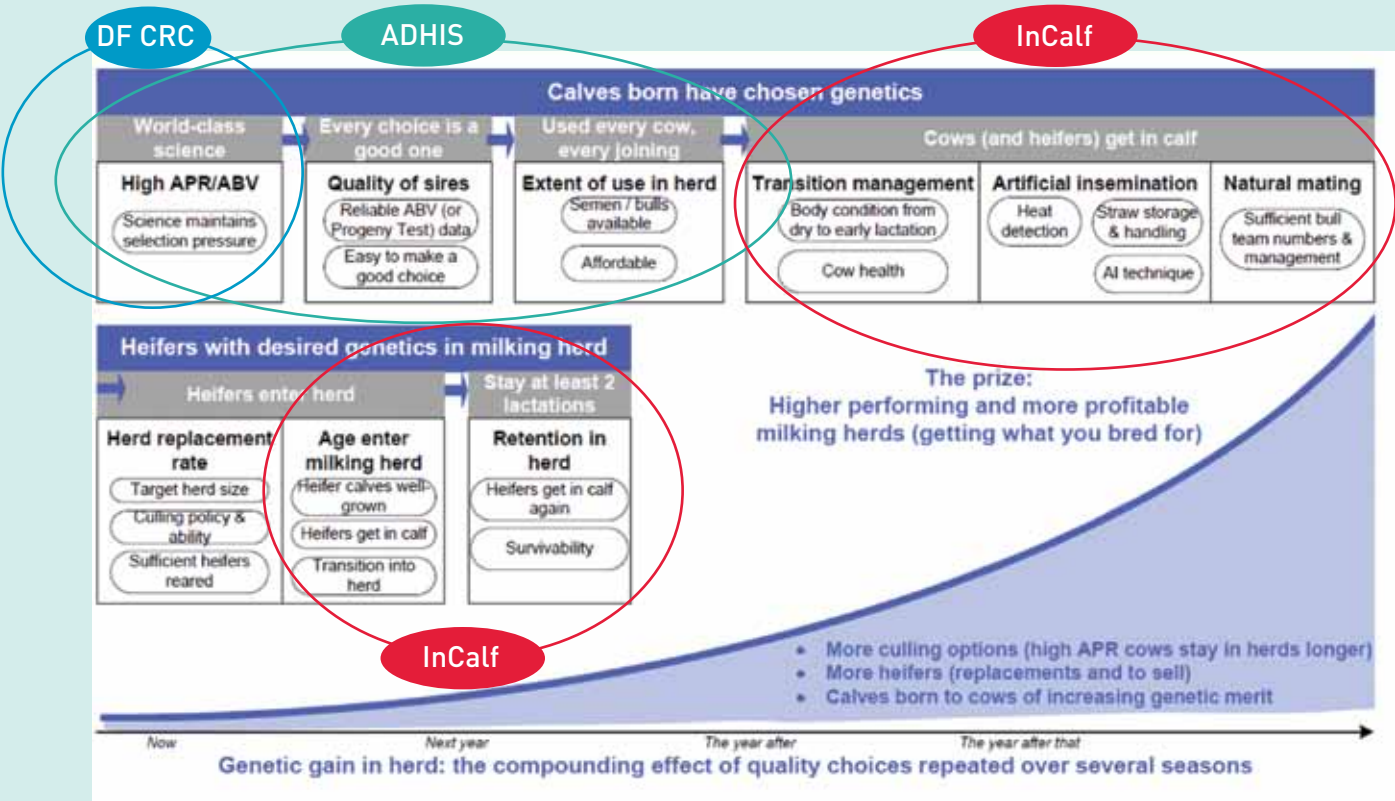
Improved data systems as an Industry Resource	Better physical and financial data collection and use on farm
<b>Objectives</b> <ul style="list-style-type: none"> <li>To identify value proposition to farmers and industry</li> <li>To streamlining of dairy data systems</li> <li>To facilitated data sharing and exchange</li> </ul>	<b>Objectives</b> <ul style="list-style-type: none"> <li>To provide easy and accurate data capture tools</li> <li>To develop improvement tools to interrogate data</li> <li>To overcome barriers to interrogating data into cow/herd management decisions</li> </ul>
<b>Expected Outcomes</b> <ul style="list-style-type: none"> <li>Greater ability to introduce new traits</li> <li>Ability to streamline / deliver R&amp;D initiatives to farmers</li> <li>Provide longer support R,D&amp;E investments including post R&amp;D phases</li> <li>Increased reliability of Genetic Evaluation</li> </ul>	<b>Expected Outcomes</b> <ul style="list-style-type: none"> <li>Increased ability to make timely on farm decisions</li> <li>Farmers view data as a valuable resource</li> <li>Farmers act on data (based on fact not perception)</li> </ul>
<b>Who should be involved</b> <ul style="list-style-type: none"> <li>Dairy Australia InCalf / Countdown</li> <li>NHIA Researchers / Vets</li> <li>ADHIS Milk Companies</li> <li>Herd Recording Centres Gardiner Foundation</li> </ul>	<b>Who should be involved</b> <ul style="list-style-type: none"> <li>Dairy Australia Herd Recording Centres</li> <li>NHIA InCalf / Countdown</li> <li>ADHIS Researchers / Vets</li> <li>DPIV Milk Companies</li> </ul>

## Extension and Education Services to assist improvements in Genetic Selection, Fertility and Culling decisions

Ensuring R&D activities are uniformly and effectively extended throughout the industry

Improved farmer decision for breeding herds that perform under Australia conditions
<b>Objectives</b> <ul style="list-style-type: none"> <li>To integrate messages across the Genetic Improvement supply chain to ensure uniformity of message and clarity of purpose</li> <li>To enable farmers to address specific farming systems strategies (extended lactation, cross-breeding, split calving, joining)</li> </ul>
<b>Expected Outcomes</b> <ul style="list-style-type: none"> <li>Clarity / Agreed messages around breeding / joining options and strategies</li> <li>Better decision making on farm</li> <li>Improved confidence (both farmers and advisors) to deal with genetic / reproduction / farming system issues</li> </ul>
<b>Who should be involved</b> <ul style="list-style-type: none"> <li>DEC InCalf / Countdown</li> <li>NCDEA Researchers / Vets</li> <li>ADHIS</li> <li>NHIA</li> </ul>

Figure 13. Breeding dairy herds that perform in Australian conditions—A pathway to increased profitability and support to farmers' breeding objectives



## Existing and recent key investments in milk quality and milk harvesting

Theme	Project or activity name	Organisation responsible	Completed or ongoing
1	Countdown Downunder	Dairy Australia	1998-ongoing
1	CowTime	Dairy Australia	2001-ongoing
2	Genes associated with the virulence of <i>Strep uberis</i> *	RMIT (Margaret Deighton)	Ongoing
2	Cow-side diagnostic testing for mastitis pathogens	University of Melbourne	?
2	Incidence of <i>Strep uberis</i> in the Macalister Irrigation District	Maffra Veterinary Services (Jakob Malmo)	Completed
2	Differentiating between existing and new infections of <i>Strep uberis</i>	RMIT (Margaret Deighton, Jakob Malmo)	Ongoing
2	Field evaluation of the PathoProof Mastitis PCR Assay	Dairy Technical Services	Ongoing
2	Benefit Cost Analysis of using teat sealants	Warrnambool Veterinary Clinic	Ongoing
2	Heifer mastitis incidence and factors involved	Dairy Australia (Lauren Clyne veterinary intern)	Ongoing
2	E-learning QA training for farmers	NCDEA	Ongoing
2	Effective cow mastitis vaccination: growth curve tests	RMIT (Margaret Deighton)	June 1998-ongoing
2	Incidence of <i>Mycoplasma bovis</i> in eastern Australia dairy herds and development of molecular diagnostic tests	Geoffrey Gardiner Dairy Foundation (University of Sydney, John House)	Ongoing
2,7	APVMA guideline for when new chemicals are registered	Dairy Australia (Technical Issues Group)	Ongoing
3	Use of Bovine Viral Diarrhoea testing in high BMCC herds	University of Adelaide (Michael Reichel), Bega RLPB	Ongoing
6	Better understanding of liner compression to control its effects on teat end condition	(Doug Reinemann, University of Wisconsin)	
6	Research into various aspects of Automatic Milking Systems	Future Dairy (Dairy Science Group)	Ongoing
7	Green Cleaning Project	Victorian Government's Sustainability Fund, Geoffrey Gardiner Dairy Foundation (AgVet)	Aug 2008- ongoing
7	Milking plant hygiene training pilot	NCDEA, WCBF (Gabby Hakim)	Ongoing
7	Milk cooling	Dairy Australia (Technical Issues Group)	Ongoing

\*Tomita T et al (2008) Identification of *Streptococcus uberis* multilocus sequence types highly associated with mastitis *App Environ Microbiology* 74(1): 114–124

## Appendix 2—Overcoming issues and practices which impact on cow productivity health and welfare

### ATTACHMENT 1

#### Summary of Current Heat Stress Program

##### Recent / current projects

##### Cool Cows program

##### Contact(s)

Steve Little

##### Status

Ongoing

##### Objectives / key components

##### *Overall objective*

- To develop the capacity of Australian dairy farmers to deal effectively with heat stress and minimise its impacts on herd productivity, fertility, health and welfare (and avoid unnecessary changes in farm production systems)

##### *Key components*

- General information on heat stress and its impacts on dairy cattle
- Processes, information and tools to support farm infrastructure investment decisions, herd management and feeding strategies
- Tools to help farmers assess herd susceptibility, anticipate excessive heat load events during hot season, look back on impacts of heat stress on past herd production and reproductive performance

##### *Outputs*

- Heat stress technical group formed June 2008
- Cool Cows booklet and website developed and released Nov 2008
- > 50 Cool Cows on-farm workshops delivered across Australia in 2008/09 and 2009/10 hot seasons plus several conference / seminar presentations to farmers and service providers
- Visit to Australia by Bob Collier, Uni. Of Arizona, Feb 2010
- Cooling infrastructure options project (key design principles, strengths, limitations, 18 case study farms) completed by FSA Consulting in March 2010
- Murray Dairy heat stress impact study completed by CSIRO April 2010
- Infrastructure fact sheets (in development for release Nov 2010)
- Benefit : Cost Analysis web tool (in development for release Nov 2010)
- Further farm workshops in 2010/11 hot season as requested by regions
- Co-ordination with other heat stress R & D projects (see below)

## QDO / STD climate change project 2009–11

### Preparing dairy farmers for climate change

#### Contact(s)

Rick Kowitz

#### Status

Ongoing

#### Objectives / key components

Overall objective:

- To support farmers dealing with climate change (including heat stress)
- Key components
- Farm workshops
- Case study farm(s)

Outputs:

- Series of 3 pilot farm workshops on cooling infrastructure delivered in 2009/10 hot season.
- Further workshops planned in 2010/11 hot season
- Case study farm(s) in SEQ to monitor heat stress impacts and demonstrate mitigation strategies (to commence October 2010)

## Heat stress research project

### Amelioration of thermal stress impacts on animal performance and welfare in southern Australia dairy, beef and sheep industries

#### Contact(s)

Frank Dunshea, John Gaughan (plus collaborators at Monash Uni, Uni. Arizona, Uni of Iowa)

#### Status

Ongoing

#### Objectives / key components

Overall objective:

- Develop the Accumulated Heat Load Index (AHLI) for use in grazing dairy cattle
- Better understand heat stress physiology and animal responses to dietary interventions

Components:

- Monitoring study using dairy herds at Uni. Melb. Dookie & UQ, Gatton
- Dietary intervention studies

Outputs:

- Proposed Accumulated Heat Load Index (AHLI) for use in grazing dairy cattle (in 2011–12)
- Reports on heat stress physiology and animal responses to dietary interventions including betaine, zinc, chromium, magnesium, tryptophan, plant alkaloids (in 2011–12)



## Calf management across the supply chain – DRAFT

The Australian dairy industry has a vision to be leaders in the care of our animals to enhance our record for animal care, ensuring community confidence and market access.

As a key priority within the National Dairy Industry Animal Welfare Strategy Dairy Australia is making a substantial investment on behalf of the dairy industry into ensuring that all calves are managed across the calf supply chain to meet agreed industry practices and standards.

The Calf Management Program has been developed to address the health and welfare of all dairy calves and includes communicating with farm workers, transporters, saleyard operators and meat processors. There are three objectives within the Calf Management Program which are to:

- › Ensure that all people working across the supply chain are aware of and are delivering on their responsibilities for good calf health and welfare outcomes.
- › Provide assurances to government, consumers and the public that the calf supply chain is meeting its responsibilities.
- › Confirm that recommended practices are underpinned by robust science and supported by appropriate industry tools and systems.
- › Since the inception of the National Dairy Industry Animal Welfare Strategy in 2003 there have been many significant achievements concerning calf management.

**OBJECTIVE 1: To ensure that all people working across the supply chain are aware of and are delivering on their responsibilities for good calf health and welfare outcomes.**

### Activities

- › A list of industry agreed Essential Components for the management of all dairy calves across the supply chain has been established to include pre calving, traceability, feeding, a protective environment, health management, residue management, weaning and preparation for sale or transport to ensure good animal health and welfare outcomes.
- › Surveys of farmers to find out about current practices in calf rearing and management for comparison against the essential components were undertaken to identify potential management issues that could result in adverse health and welfare outcomes for calves.

- › Group discussions with farmers were used to test the practicality and likelihood of adoption of recommendations for improved calf management.
- › Information has been developed and distributed to farmers and calf handlers on calf management practices using information gained from the review of current practices against industry agreed recommendations along with relevant Codes of Practices and Standards and Guidelines for calf welfare.
- › Healthy Calf workshops on good calf management for farmers are being delivered in conjunction with the Dairy Extension Centre (DEC) and the National Centre for Dairy Education Australia (NCDEA).
- › Development of resources for humane slaughter workshops to be delivered through NCDEA and appropriate service providers.
- › In collaboration with the Meat Industry Training and Advisory Council (MINTRAC), and the NCDEA, training resources have been developed to support formal competencies in the managing and handling of calves destined for slaughter for people working with calves from farm to slaughter including transport and saleyard operators.
- › Articles in rural media such as company newsletters and the Australian Dairy Farmer magazine are regularly published to remind farmers of their responsibilities for calf welfare and residue management.
- › Collaboration with cattle vets has increased their communication with farmers including on responsibilities for calf welfare and residue management.
- › Improvements in the tracing of calves from farm to slaughter through the calf supply chain integrity trial has enabled:
  - The monitoring and investigation of animal health and welfare issues
  - Feedback to dairy farmers on the residue and welfare status of calves sent to processors
- › Reporting of residue test results and investigations of residue incidents has resulted in greater awareness of the importance of antibiotic residue management and the factors contributing to residue detections.

**OBJECTIVE 2: Provide assurances to government, consumers and the public that the calf supply chain is meeting its responsibilities**

*Activities*

- Current practices have been benchmarked to identify and report on continuous improvement in calf management.
- Media articles and reports on the work being undertaken and progress achieved in calf management are regularly published.
- The electronic tracking of calves from farm to slaughter is undertaken to monitor and investigate animal health and welfare issues.
- The dairy industry contributes to the development of Australian Animal Welfare Standards and Guidelines for Livestock.
- Components of calf management have been incorporated into on-farm quality assurance programs.
- Key stakeholders in calf management are engaged through the Australian Dairy Farmer (ADF) Strategic Reference Group for Calf Management.

**OBJECTIVE 3: Confirm that recommended practices are underpinned by robust science and supported by appropriate industry tools and systems.**

*Activities*

- Cattle vets are provided with appropriate information for them to pass on to farmers about good calf health and welfare practices.
- A trial using NLIS tags has been developed to enhance traceability of calves from farm to slaughter with support from ADF and AMIC and co-funding from DAFF and DPIV to:
  - Develop and introduce supporting software to enable traceability from farm to slaughter
  - Produce reports to enable the on-going monitoring of the health and welfare of calves sent to slaughter.
- A project to enable an understanding of antibiotic residue management in the context of current calf management practices has been implemented through a monitoring and investigation process.
- Dairy Australia has funded science based research and reviews to support the development of industry recommendations and Australian Animal Welfare Standards and Guidelines for Livestock including:
  - a review of calf physiology and suitability for transport in first week of life
  - a review of management of painful husbandry

processes in calves such as disbudding

- an assessment of cow and calf behavior and stress associated with time of separation of calf from dam
- science based research to support a maximum time off feed for bobby calves being transported to slaughter.

*Program Outcomes*

- A national, common understanding of what contributes to good calf management.
- On-going monitoring of animal husbandry practices demonstrate that dairy farmers are implementing robust calf husbandry and management systems, in line with industry agreed practices and standards.
- Industry agreed practices and standards for calf management are underpinned by contemporary science and research.
- Animal health, welfare and potential residue risks of calves are effectively managed through attention to high priority aspects.
- Calf management systems are able to withstand the pressures put on the system during peak calving periods
- Meat processors and regulators are confident that the dairy calf management system delivers calves that do not pose risks to the meat industry
- The entire dairy calf supply chain is working together to meet animal welfare and food safety objectives.

## Appendix 3—Investigate novel approaches to improve farm productivity

Overview of themes, R, D or E activities in the next 5 years in priority area 4

Theme	Activities	Main Focus	Industry change/outcome
1. Maximising the potential benefits of AMS	Independent consultants and extension specialists increase knowledge of AMS and become regional “champions”	E	Farmers choosing AMS for the right reasons and with realistic expectation. Readily available support to farmers during and after commissioning to ensure they have the opportunity to capture vast benefits of AMS within a short time-frame of commissioning.
	Examine the investment and post-installation period of AMS users to develop lessons for new users	R	Farmers can make an informed choice around AMS investment
	Build a framework for increasing industry support capacity	D	The dairy industry has the capacity to support AMS users both at a private and public level
	Create a forum in which open discussions and presentations assist in developing research direction, tailoring of equipment (esp. Software) to our industry	D, E & R	Technology becomes better suited to our industry, research direction is driven by true needs, farmers learning from each other and networking to improve total business success.
2. Maximising the benefits of automatic sensing systems	Create resources to inform dairy farmers of the opportunities and potential pitfalls of these technologies	D, E	Farmers are able to maximise the functionality of automatic sensing technologies in their particular system context.
	Build capacity for support by increasing the pool of potential facilitators	R, D	Individual management of cows based on effortless collection and automatic interpretation of reliable data.
	Establish clear reference standards for evaluating and comparing sensing systems	D, E	There is a real incentive for farmers to share on-farm data with the wider industry
	Investigate the link between on-farm data collection and national industry data needs		
3. Supporting industry innovation in automation and IT	Investigate structures for continuous innovation around automation and IT.	R, D,	Knowledge created by farmers is captured and made available to the wider dairy industry thereby increasing the value achieved from automation investments
	Highlight the value of ongoing learning around IT use, and use of IT-derived data, on farm.	E	Farmers place a greater value on IT learning as a key function of their business performance
4. Understanding the value of best practice in Milk Harvesting	Promotion of existing resources developed by CowTime.	E	Industry is aware of the importance of good milk harvesting practices and values the activity.
	Maintain some capacity in milk harvesting in general which is disappearing. As the older generation retires, it is important to maintain credible, independent information sources and the capacity to provide the “train the trainer” function for the industry through the NCDEA.	D, E	This may help with the acceptance of the value of more management based on the cow rather than just at a herd level.

## NHIA Dairy Industry Data Project

### Executive Summary

#### Objectives

Current arrangements of data collection in Australia's dairy industry and improvements for data collection, transfer and access are reviewed and analysed in this report. A centralised repository scenario is recommended in order to improve dairy data in Australia.

The report is divided into the following 4 sections:

- **Stocktake:** documents the drivers, stakeholders, current and future needs and value chains relating to dairy data in Australia.
- **Analysis:** discussion of stocktake findings in terms of whether dairy data is sufficient, and challenges and opportunities to improve dairy data.
- **Scenarios:** sets out the 4 scenario options modelled to improve dairy data.
- **Recommendations:** a preferred scenario based on a qualitative benefit-cost scenario and quantitative analysis is recommended.

#### Context

*"We believe that the time is right for the Australian dairy industry to make a significant effort to adopt a dairy data system that is world's best practice, which enables dairy farmers to make informed and timely management decisions on their farms,"*

– Dr Schaffer, NHIA Working Group Chairman.

There is an overwhelming consensus between dairy industry stakeholders that the way dairy data is currently exchanged limits potential productivity gains from herd improvement for the Australian dairy industry.

The profitability and international competitiveness of the Australian dairy industry depends on a continual improvement in dairy herd data. The industry has made a substantial investment to build a body of high-quality scientific knowledge with the expectation that this will underpin decisions regarding the selection of desirable traits.

Repositioning dairy data exchange into a pre-competitive setting is essential to support research, improve genetic evaluation and underpin information product innovation across the industry to realise productivity gains through better on-farm decision making. This report has found that Australia could achieve gains of \$10-\$50 million during the next 10 years if farm level data management was improved.

#### Key Issues

Five main drivers which are both supporting, and in some cases inhibiting improvements in dairy data collection, transfer and access are identified in the report. These include; better decision making information, sustaining genetic evaluation data flows, rationalisation, innovation and technology, and regulatory and market compliance.

The report identifies three value chains for dairy data; herd recording; breeding, fertility and herd management; and food and safety/quality and environment, for which challenges and opportunities are identified. Many of the existing gaps and issues identified are concerned mainly with the quality and quantity of data, particularly relating to collection and integration.

The main challenges identified include:

1. Lack of industry leadership to address data issues and realise productivity gains
2. Multiple animal ID processes and numbers with calls for implementing a unique recognised animal ID system
3. Gaps in data; value adding constrained
4. Fragmented systems, difficulties in data transfer and sharing
5. Less than optimal data collection processes and adoption of new technologies
6. Reduced data flows through the data value chains
7. Improvements in reliability of genetic evaluation
8. Data not valued by all stakeholders
9. Incentives for data collection not aligned with benefits of data use.

These challenges present opportunities to the industry for improvement in dairy data collection, transfer and access. These opportunities can be pursued and challenges addressed by a mixture of education; regulation push and market pull to establish the elements of a desirable system as outlined by stakeholders.

#### Options

Four scenarios were modelled in this report. These scenarios are based on the level of which two key variables impact on the dairy data: market forces and the level of intervention. The purpose of the scenarios is to provide strategic insight and test their ability to realistically improve data management in the dairy industry to identify a preferred pathway. The four scenarios tested are:

1. Laissez faire – market drives rationalisation and increasing demand for better information products from herd data.
2. Standards Drive Approach – focus on standardisation and data flow
3. Centralised Data Repository – builds on Scenario 2 by establishing a pre-competitive herd testing/data approach through the development of a national Data Repository.
4. Full Integration – builds on Scenario 3 by establishing a single unified data architecture and software system.

### Recommendations

Scenario 3 will provide the best outcome through combining an industry owned data repository with extension services and the standards based approach of Scenario 2, to address both the leadership and technical issues associated with dairy data. This scenario is considerably more than enhancement of the current system because it requires equity, participation and commitment from all stakeholders to be effective.

A staged approach progressively designing, testing and implementing the components is proposed. It is recommended that the Data Working Group continue to drive this initiative to oversee the key tasks required.

The implementation of Scenario 3 requires the establishment of three components; National Data Network, Data Repository and Extension Services; integrated through a strategic plan and underlying business model. This report has included a detailed description of the key tasks, risk analysis and timelines that need to be undertaken to implement Scenario 3.





# DAIRY MOVING FORWARD



Natural resource management and climate change

## NATURAL RESOURCE MANAGEMENT AND CLIMATE CHANGE RD&E STRATEGY



## Acknowledgements

**The development of a new Research, Development and Extension (R,D&E) strategy in Natural Resource Management and Climate Change (NRM&CC) for the Australian dairy industry has involved extensive consultation and inputs from a wide cross section of dairy industry stakeholders.**

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## 1. Executive Summary

*“Maintaining the right to access and utilize, and managing the costs and availability of key production resources exists as a priority in all our dairying regions. . . . . A perception of unsustainable use of resources is a domestic and international market risk. It is clear that dairy needs to be articulate and well informed about our own performance and the science and practice underpinning that performance.”*  
(Dairy Moving Forward, 2009)

At a stakeholder workshop in early 2010 six Natural Resource Management (NRM) and Climate Change (CC) RD&E outcomes were identified for further development into comprehensive RD&E strategies. These outcomes were:

- An agreed pre-farm gate sustainability reporting framework
- Increased industry confidence to manage climate change
- Increased industry capacity to reduce farm greenhouse gas emissions
- Long term sustainability of nutrient use through greater understanding of nutrient pathways
- Improved extension of nutrient management principles and practices
- Increased profit per unit of water use on irrigated dairy farms.

Through a workshop process involving expert groups selected from a wide cross section of industry stakeholders, dairy industry strategies and key investment areas for each of the six priority outcomes were identified. Members of the expert groups were also asked to quantitatively rank the priorities for future investment. The highest ranked RD&E priority areas for each of the outcomes are summarised in Figure 1.

During the workshop process a number of underlying issues emerged that may impact on the capacity of the

industry to achieve the overarching DMF NRM and CC outcome. Some of these issues are:

- The decline in Government and NGO funding for industry NRM programs over the last five years.
- The fragmented nature of on farm environmental reporting and its reliance on project or case study narratives.
- The need for an integrated approach to climate change adaptation and mitigation issues. CC RD&E should be incorporated into existing feedbase, business management and animal programs and should not be dealt with in isolation of other farm activities. Climate change is not a specific and isolated risk for dairy farmers – it is an extra uncertainty to be blended in with existing risks that compound to form the overall farm business risk.
- A lack of confidence in the currently promoted soil nutrient targets and management principles among some service providers and farmers.
- Significant knowledge gaps around nutrient transformations from a whole farm systems perspective.

All expert groups noted the interdependencies of several NRM&CC RD&E priorities, with other DMF planning areas including Feedbase and Animal Nutrition, Farm Business Systems, Animals and People. In the following table priority areas followed by an asterisk offer the greatest opportunities for cross program development.

Members of the expert groups were also asked to identify capability gaps for each of the RD&E priority areas. Generally people capability was considered to be reasonable with resourcing and leadership being the major areas of concern.

Figure 1: A summary of the natural resource management and climate change research priority



\* Opportunities for cross development



## 2. Introduction

In September 2009, the Dairy Moving Forward Steering Committee agreed that Natural Resource Management (NRM) and Climate Change (CC) was one of five focus areas that required further work to progress the development of specific RD&E priorities. The rationale for inclusion of NRM & CC as a key area in this DMF planning framework was outlined in DMF documentation in September 2009 as follows:

*"Maintaining the right to access and utilize, and managing the costs and availability of key production resources exists as a priority in all our dairying regions. The dairy industry is a responsible and effective user of the resources in question (land, water, animals, energy and nutrients) and wishes to be seen as such in the wider community, including the domestic and international trading community."*

*Competition for resources (tourism, environment, community, urban expansion) is increasing. Scrutiny of practice and requirements for transparency (eg nutrient use; animal welfare; water utilization) are increasing and welcomed by dairy. Legislative "risk" is a potential access and pricing issue associated with resources (Greenhouse gas policy; water policy). A perception of unsustainable use of resources is a domestic and international market risk. It is clear that dairy needs to be articulate and well informed about our own performance and the science and practice underpinning that performance."*

The DMF steering committee also agreed that further detail was required in each focus area, specifically:

1. Prioritisation of R,D & E needs within and across each of the 5 focus areas.
2. An evaluation of the capacity (people and infrastructure) to deliver to those needs.

## 3. Situational analysis

Industry NRM and CC priorities were identified through analysis of the 2009 Dairy Regional Natural Resource Management (NRM) Action Plans, the Australian Dairy Industry Council 2007 NRM Strategy, the Dairy Australia Confidence to Grow program, the Lower Murray-Darling Basin: the Facts, the Future report, targeted market research and stakeholder consultation.

- **Regional NRM Action Plans (RAPs):** In 2009 all Regional Dairy Programs reviewed their Natural Resource Management Action Plans. A wide range of stakeholders including dairy farmers, advisors and state and local government staff with key roles in Natural Resource Management were consulted as part of this process. [www.dairyingfortomorrow.com](http://www.dairyingfortomorrow.com) > **on-farm change > Regional Action Plans**
- **Stakeholder consultation:** Whilst the RAPs are an excellent resource for identifying regional priorities additional consultations were held with dairy farming

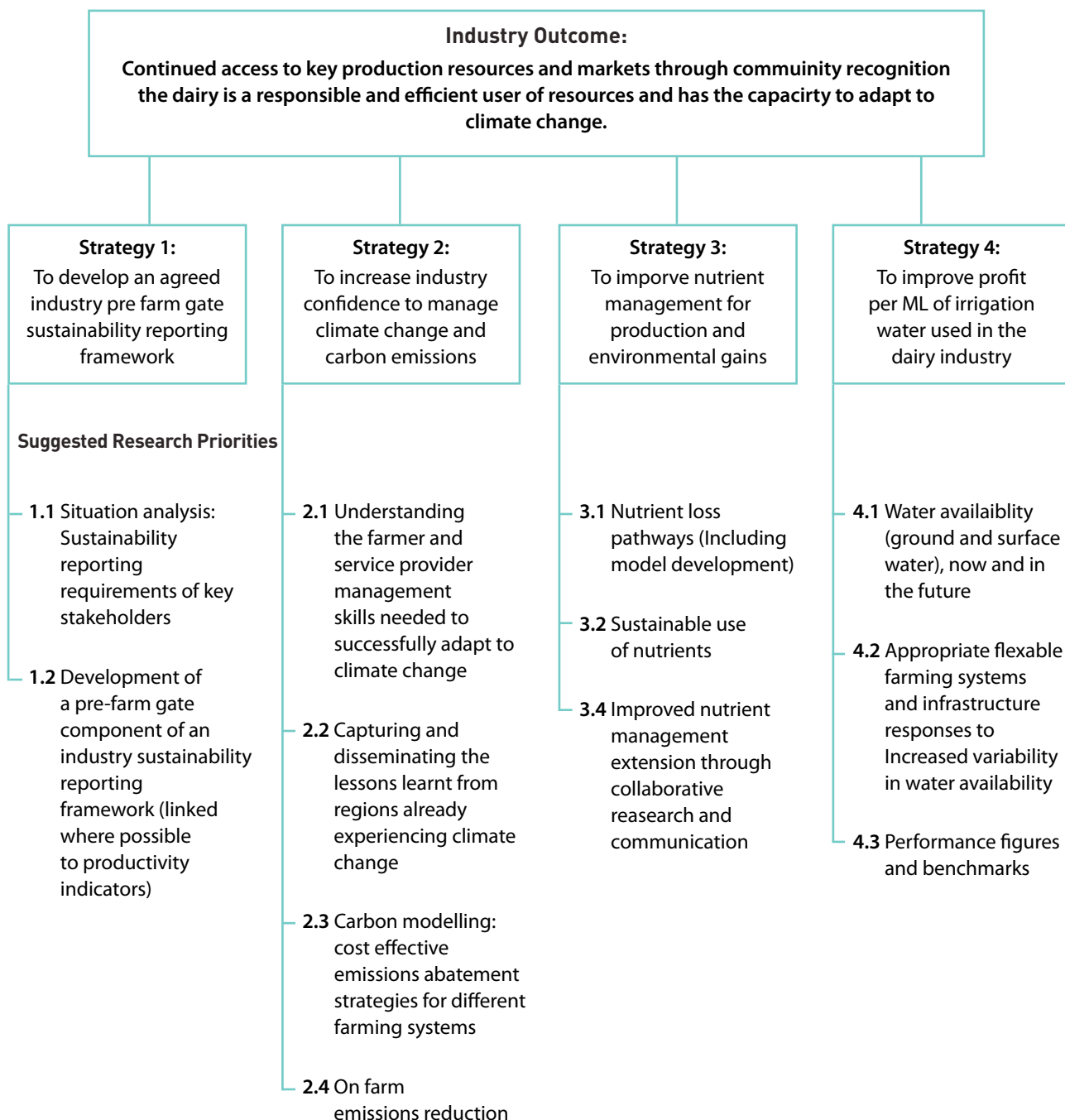
organisations, milk companies, regional NRM agencies, research organisations and environmental lobby groups to identify and discuss existing and emerging national and international issues such as carbon footprints.

- **Confidence to Grow:** Between 2007 and 2010 Dairy Australia conducted a major program of work to identify the challenges and opportunities associated with reducing carbon pollution and the longer-term challenges associated with a changing and more variable climate. [www.dairyingfortomorrow.com](http://www.dairyingfortomorrow.com) > **research programs > climate change**
- **Lower Murray-Darling Basin: the Facts, the Future:** In 2009 the dairy industry commissioned an independent inquiry into the key drivers that will influence the future of the dairy industry in the Lower Murray- Darling Basin. [www.dairyaustralia.com.au](http://www.dairyaustralia.com.au)

## 4. Project Logic

The research priorities for NRM and Climate Change identified through the situational analysis are summarised in Figure 2, and consist of an overarching outcome, strategies to achieve the outcome and the suggested RD&E areas needed to drive the strategies.

Figure 2: Project Logic



## 5. NRM & CC Planning Process and Methodology

The results of the situational analysis including the proposed outcome, strategies to achieve the outcome and the suggested RD&E priority areas were presented to an industry stakeholder workshop in March 2010. From that workshop the following six Natural Resource Management RD&E outcomes were identified for further development into comprehensive RD&E strategies.

These outcomes were:

- › An agreed pre-farm gate sustainability reporting framework
- › Increased industry confidence to manage climate change
- › Increased industry capacity to reduce farm greenhouse gas emissions
- › Long term sustainability of nutrient use through greater understanding of nutrient pathways
- › Improved extension of nutrient management principles and practices
- › Increased profit per unit of water use on irrigated dairy farms.

Expert groups corresponding to each of the six NRM&CC outcome areas were established in June/July 2010. Each expert group included researchers, consultants, advisers, farmers, and processors with nationally recognized expertise of relevance to each outcome area. Membership of the expert groups is indicated in the Acknowledgements section of this report. The expert groups were led by:

- › Patten Bridge (Murray Goulburn)—sustainability reporting
- › Warren Mason (Dairy Australia)—climate change
- › Julian Hill (Consultant)—greenhouse gases
- › Kevin Kelly (DPIV)—nutrient pathways
- › John Mulvany (Consultant)—nutrient extension
- › Mike Morris (DPIV)—irrigation.

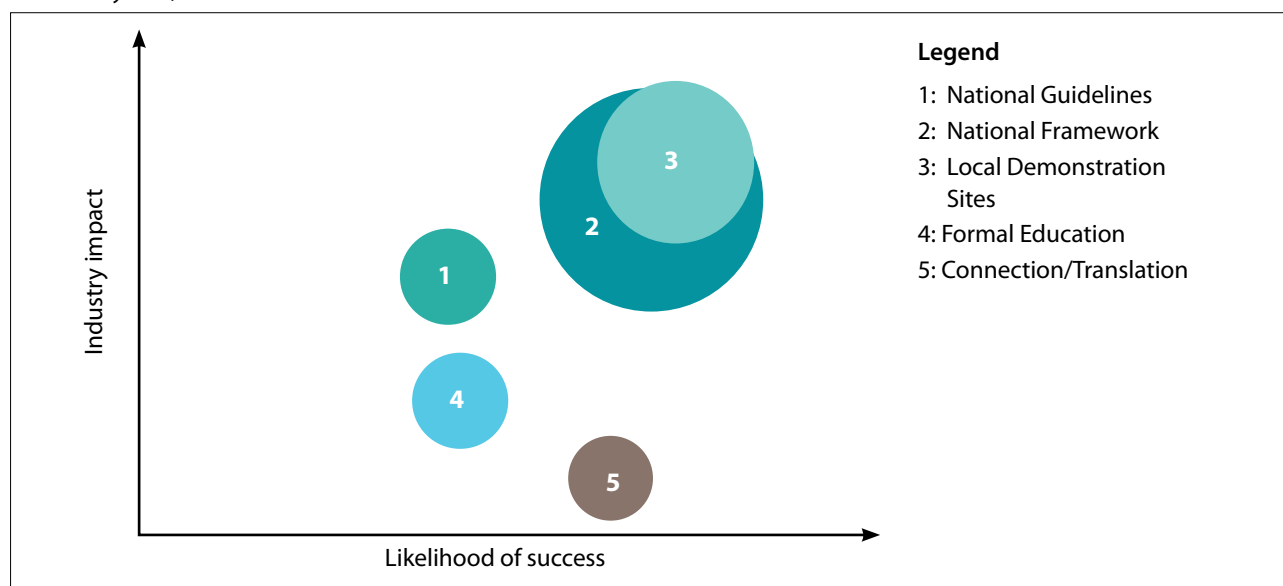
Workshops involving the expert groups were held in Melbourne in the period 14th July–4th August 2010. Each group leader prepared and presented an overview of current relevant R,D&E activities and industry needs to their workshop group. Group members then explored the issues associated with delivering against the priority outcome.

The facilitator of the workshops produced a summary report from each workshop in conjunction with the group leader. The workshop summaries covered background issues raised, industry needs to enable achievement of the priority outcome and suggested key investments in R,D&E activities. Workshop summary reports were distributed to all workshop participants for comment and ratification shortly after each workshop.

Draft plans for each priority outcome were prepared based on the feedback provided by the workshop participants and other key stakeholders. These draft plans were circulated to members of the expert groups and additional experts where appropriate for final comment and ratification. As part of this process members of the

### Impact vs Success

Figure 3: Example of a likelihood of success vs industry impact graph (size of the bubble indicates scale of investment needed within that activity area)\*



\* Estimations of impact, likelihood and scale of project are qualitative only and reflect the opinion of the Dairy Moving Forward expert working group

expert groups were asked to quantitatively rank the priorities for future investment by placing them on a 'likelihood of success' vs 'industry impact' graph. An example of the graph is provided in Figure 3.

Individual feedback was collated to provide a summary of the quantitative ranking of impact and likelihood of success as rated by the expert group for each priority outcome. A similar process was used to identify capability gaps. An example of the capability reporting template is provided in Figure 4.

Feedback on the draft plans, the quantitative rankings of impact and likelihood of success for each of the proposed activities and the comments on relevant capability form the basis of the following RD&E strategies for each of the six Dairy Moving Forward Climate Change and NRM outcomes.

*Figure 4. Example of a capability reporting template*

In the table below, for each of the 5 activity areas from the workshop report, please give a rating (1 to 5, where 1 is 'no current capability (capability is a reflection of skills and resources) in this area' and 5 is 'current capability is fully able to deliver this activity area'. If the rating is 5, then little comment is probably needed other than where the capability currently resided. However, for lower ratings, it is important that we get a feel for the specific gaps you see—these might be in particular regions, or might be particular skills that are not available etc. The key point is that it's no good giving a rating of (say) 3 and not giving details of what actually makes up the capability shortfall.

Investment Area	Capability Rating (1–5)	Comments
National Guidelines	4	We have the information & expertise, we just need to lead coordination, collate the science, communicate the evidence and demonstrate the outcomes.
National Extension Framework	3	Capabilities are less and less as time passes through government personnel. Big need here to engage the fertiliser industry.
Local demonstration sites	3	Is definitely a "must do" and "can do" where good consultants exist to drive the projects in certain regions. Some regions with lack of good expertise may struggle to get this together and will need more resources.
Formal education	3	Again, we have the data and information- need a lead on the collation and communication. We can't rely upon gov departments- need good consultants at regional level and MUST involve the fertiliser industry (esp. Fertcare).
Formal education	5	Where there is a will, there is definitely a way! This can happen easily—need a coordination lead and MUST include the fertiliser industry (excellent way to engage them).

## 6. Priority Outcome 1: An agreed industry pre-farm gate sustainability reporting framework

Within the NRM & CC arena the outcome “*An agreed industry pre-farm gate sustainability reporting framework*” relates to all the Dairy Moving Forward NRM and CC outcomes. If the industry agrees that such a framework is necessary it is highly likely the agreed reporting indicators will be directly linked to industry capacity to reduce greenhouse gas emissions, sustainable nutrient use, responsible use of water, biodiversity and industry capacity to adapt to increased climate variability.

### 6.1. Background context

#### **The Australian dairy industry is under pressure to provide evidence of its sustainability credentials.**

Many dairy companies in Australia and internationally are experiencing some pressure from their customers (retailers of dairy products; major food processors such as Kraft, Danone, Unilever, Nestle etc) to report on the sustainability of their products and their supply chains. One key driver is demand from consumers—both domestic and export—who are increasingly wanting more supply chain (on farm/ off farm) sustainability information. At a local level some dairy farmers in high value aesthetic regions such as coastal plains and/ or high population density areas are experiencing increased scrutiny from their communities about the environmental impacts of dairy farms.

The dairy industry relies on access to natural resources such as land and water for its ongoing existence and takes on the responsibility for their ongoing care and good use. Similarly the Australian dairy industry is committed to a high standard of animal welfare. However the industry does not currently have an evidenced based sustainability reporting system. Evidence to support its claim that it is a ‘responsible user of resources at the pre-farm gate level’ is based on case studies and the Dairying for Tomorrow survey of NRM practices by Australian dairy farmers (conducted every 5–6 years).

DairySAT is seen by some dairy companies as providing a basis for voluntary reporting of environmental management practices by farmers. However there are weaknesses in some aspects (particularly effluent management) and there is generally a paucity of technical support for farmers to interpret DairySAT and to apply best management environmental practices.

**There are currently no nationally or internationally agreed definitions of ‘sustainability’ reporting.**

The definition of sustainability varies widely—both nationally and internationally. It can encompass issues such as animal welfare, labour, ethics, greenhouse gas emissions and financial viability—as well as more “mainstream” environmental issues such as water use, biodiversity impacts, greenhouse gas emissions and soil degradation.

Global standardization of sustainability reporting is a desirable goal and the Sustainable Agriculture Initiative (SAI Platform) has prepared a set of draft pre-farm gate sustainability principles and practices for dairy. Key international Food and Drink companies involved in developing the SAI Platform dairy principles include Kellogg’s, Unilever, Danone, McDonalds and Fonterra.

Some international and multi industry sustainability reporting frameworks have been developed (e.g. the Global Reporting Initiative- GRI). Such frameworks have “built in” processes for defining which indicators of sustainability are relevant in particular circumstances (materiality). The process can cover economic, environmental and social indicators.

Most consumers are suspicious about attempts at “green washing” i.e. superficial claims about the sustainability of certain products or production systems and are looking for the rigor behind reporting schemes. An example is the “Ethical consumer guide” <http://www.ethical.org.au>.

#### **The Australian dairy industries choice of reporting framework must be related to data that can be practically collated.**

Farmers see value in voluntary sustainability reporting for two reasons, firstly that some customers for dairy products want this information and there may be related market access or pricing benefits; secondly some also recognize that sustainability reporting and monitoring may lead to reduced inputs and costs and improvements in overall farm system “health”. Generally farmers do not want a situation where regulatory compliance is a driver of sustainability reporting, however they also want extra work and costs associated with sustainability reporting to be kept at a minimum.

Without clear price or market access signals it is acknowledged that it is very difficult to put a value on environmental compliance for dairy farmers. It’s currently seen as “doing the right thing”, but it is recognized that in the future there may be regulatory or market access drivers for compliance.



### There is uncertainty around “who” should be responsible for sustainability reporting

There is uncertainty about whether it is a peak industry body’s role to drive development of sustainability reporting. Given that it is the dairy companies which are under pressure from their customers (retailers, food processors); maybe it can be left to them to develop sustainability reporting protocols. If DA is involved from a peak body perspective it would be around its goal of protecting “Brand Dairy”, and of providing a mechanism for minimizing duplication in data collection between companies. Companies will decide how to represent their company level positions.

The Australian wine industry has been down the track of developing an industry-wide sustainability reporting framework. Some lessons from the wine industry process are:

- Wine consumers are not specifically looking for sustainability information when purchasing wine
- Retailers are, however, looking for evidence of sustainability from their suppliers
- The sustainability information must cover both on-farm and off-farm segments of the supply chain
- The process for establishing consensus on an industry agreed list of, ultimately, 12 sustainability indicators was long and tortuous
- The selected indicators should not be driven by regulatory requirements, but must be clearly defined; measurable or collected at little marginal cost to growers and processors; and must meet the expectations of all industry stakeholders (from producers to retailers).

The expert group believes that these lessons are likely to apply in the Australian Dairy Industry context. In addition it should be noted that there is an extensive international effort to present a more coordinated and comprehensive response from the Dairy sector, around environmental issues relevant to key stakeholders.

### 6.2. Industry needs and strategies to achieve the outcome

The expert group reached consensus on the following industry needs.

#### ➤ The dairy industry does need a sustainability reporting framework

- This sustainability reporting framework must encompass both pre-farm gate and post-farm gate elements of the supply chain. It will be preferable to utilize an existing, credible and internationally recognizable reporting framework, rather than develop a dairy reporting system in isolation of existing frameworks. The Global Reporting Initiative is seen as providing a likely model.

#### ➤ Stakeholder analysis is a key requirement

- Prior to determining which sustainability indicators should be used, the dairy industry needs to determine what key stakeholders’ needs are. These stakeholders include producers, dairy companies, government (regulators), food processors and retailers. Consensus on a core set of sustainability indicators which meet the majority of stakeholder needs (probably not 100%) needs to be achieved.

#### ➤ Sustainability indicators need to be clear, measurable, defensible and easily collectable without major cost and time burdens on farmers and processors.

### 6.3. Key past and existing investments

Previous industry investment in pre-farm gate sustainability reporting has been limited. There has been considerable investment in the development of environmental self assessment tools, such as the DairySAT and the Farm Nutrient loss Index, and significant levels of investment in NRM on farm change programs by governments, farmers and NRM bodies. Tools such as DairySAT and the lessons learnt from the Dairying for Tomorrow program will provide underpinning support for the development of an industry sustainability reporting framework.



## 6.4. Priorities for future investments (RD&E activities) to deliver the outcome (including the organisations that should be involved)

### Development of an Australian dairy industry sustainability reporting framework

The expert group recommended the establishment of a sustainability reporting working group with representation of major dairy companies, ADF, DA and possibly ASCA as a starting point. The role of this group would be to develop and oversee a preliminary program of work to:

- A. 1.** Undertake stakeholder analysis to determine relevant pre- farm gate sustainability indicators for the Australian dairy industry
- A. 2.** Test the GRI process to determine if it is capable of meeting stakeholder needs for sustainability reporting across the whole dairy supply chain. This would include undertaking a Materiality Analysis for the Stakeholders listed in A1
- A. 3.** Gain industry consensus on an agreed list of “whole of supply chain” sustainability indicators and an associated reporting process.

#### Organisations that should be involved:

Milk companies, ADF, Dairy Australia, other agricultural industry organisations, specialist consultants, IDF, government agencies.

## 6.5. Time frame for activities



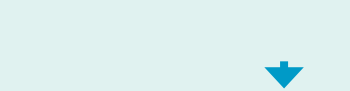

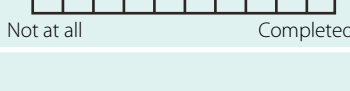
- ▶ Undertake stakeholder analysis to determine relevant pre- farm gate sustainability indicators for the Australian dairy industry.
- ▶ Test the GRI process to determine if it is capable of meeting stakeholder needs for sustainability reporting across the whole dairy supply chain. This would include undertaking a Materiality Analysis for the Stakeholders listed in step 1
- ▶ Gain industry consensus on an agreed list of “whole of supply chain” sustainability indicators and sustainability reporting framework.
- ▶ Within 12 months

It should be noted that the working group will monitor progress and agreement at each step, and progression will be based on the successful completion of the previous step.

## 6.7. RD&E priority activities currently underway

Work against this priority activity is in progress with activities A1 and A2 to be conducted between November 2010 and April 2011.

## 6.6. RD&E Capability (gaps and resources) for the Investment Priorities

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		Yes, all major milk companies agree this is a key issue for them and are prepared to allocate the necessary resources.
Do these people and organisations represent the majority of prior learning in this area?		Yes.
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		It is highly likely investment in this area will be necessary. International and national food and drink companies are increasing their demands for transparent sustainability reporting.
Would the collaborators be able to provide diverse avenues for change?		Successful implementation will be reliant on milk company collaboration.
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		Limited capability within dairy organisations but there is capability within the private sector and in other agricultural industries. Funding availability will be linked to market drivers.

## 7. Priority Outcome 2: Increased confidence to manage climate change

### 7.1. Background context

The term 'climate change' in the outcome statement is interpreted as incorporating all the challenges (adaptation and mitigation) associated with a changing climate and regulatory environment. Within the NRM&CC arena, there is a second climate change focused outcome — *"Increased industry capacity to reduce farm greenhouse gas emissions"* which is focused on developing technical solutions.

The issues listed here are a combination of the conclusions from the Confidence to Grow program, and input from the expert group workshop.

- There is **widespread uncertainty/scepticism** about the extent, and causes, of climate change and many producers believe there will be a return to the "normal run of seasons". The challenge is to position dairy projects so as not to rely on farmers declaring a belief in the climate change science.
- The general conclusion from Confidence to Grow program was that Climate Change and the surrounding debate had **eroded confidence in the industry**. Confidence is a dynamic characteristic that cannot be simply predicted on the basis of industry statistics, and if not being continually enhanced, can quickly deteriorate
- Climate change is **not a specific and isolated risk** for dairy farmers—it is simply an extra uncertainty to be blended in with existing risks that compound to form the overall farm business risk.
- The dairy industry should **not go it alone** in responding to climate change—it should collaborate with government and other industries, but ensure that communications have a clear dairy focus.
- Communications and solutions to climate challenges must be seen as practical, achievable and with **a focus on profit and business sustainability**.
- There are regional differences in the impacts of climate change and some producers in some regions are seeing **opportunities for positive outcomes**—such as warmer and drier winters.
- There are **less people** in many dairy regions on which producers can rely for advice and to help them develop a personalised solution to the climate challenges on their farm.
- The Confidence to Grow program concluded that climate change messages should be focussed around two key positive and confidence building themes:
  - Managing climate variability is and **always has been** a big part of managing a farm; and
  - Businesses that are **efficient and profitable now** are best placed, no matter the future.

### 7.2. Industry Needs and Strategies to Address the Outcome

Given the background as outlined above, the outcome (increased industry confidence to manage climate change) is not amenable to simple technical solutions, nor to the process whereby some research is carried out and then later extended to industry. Confidence emerges from the 'sum' of things and not directly from specific developments or technologies. Therefore, the following industry strategies are needed.

#### Taking an inclusive and integrated approach

A Victorian survey has indicated that there are 3 broad farmer categories with roughly equal numbers – those who do not believe in climate change; those who are undecided or ambivalent; and those who generally agree with the scientific conclusions. An inclusive approach is needed so that all dairy farmers can readily be involved in 'climate challenge' activities. A key message is that the best preparation for an uncertain future is to have an efficient and profitable dairy farm business now. There are win:wins especially around efficiency, and a 'belief' in climate change is not needed for this message to be relevant.

A key to building confidence is that individuals 'feel' that the industry is on top of the full suite of climate challenges. This involves recognising that climate is not a stand-alone challenge but another contributor to farm business risk. Dairy being seen to actively work with other primary industries and with Government, to achieve positive/collective outcomes is also an important strategy.

#### Ensuring dairy specific communication

Confidence cannot be built if the dairy industry does not have specific communication resources focussed on understanding and managing climate challenges from an industry perspective and using industry recognised language. This needs to include clear statements about possible regional climate change impacts, practical options for farmers to adopt in response to climate and

emission reduction challenges, and highlighting the positives (where they exist, such as increased winter pasture growth) and strategies that are relevant and practical right now.

### Providing practical assistance & tools that account for regional and system difference

The industry needs practical assistance/tools to help producers manage risk (climate risk, market risk, human risk) and to do business efficiently and profitably in a more variable environment. There must be a menu of options for both adapting to climate change, and for reducing dairy industry emissions – these need to range from short-term actions (ie applicable now) to longer term-to strategies so as to foster a slow but continuous build up of confidence and capability across the industry.

The industry needs to ensure that any modelling of climate change impacts (and/or the impacts of any proposed greenhouse gas reduction schemes) on the dairy industry recognises and accounts for both regional and farming system differences, and the different risk profiles involved.

### Building significant flexibility into ‘climate impact’ related RD&E

The industry needs RD&E which is flexible and responsive in the following ways:

- › RD&E professionals and producers collaborating closely in developing, trialling and evaluating practical options
- › a capacity to capture (and effectively share) lessons from the year to year variations in climate that occur across the different dairy regions
- › the ability to respond to the ‘surprises’ or extreme events that climate change delivers
- › a capacity to quantify the multiple benefits of actions in response to climate challenges, and
- › RD&E which keeps in mind the totality of likely climate challenges, the tradeoffs between adapting to climate change and reducing greenhouse gas emissions on dairy farms.

### Work with Government to influence climate policy

A major underpinning element of industry confidence is to see the industry working with Government to collectively find strategies and mechanisms to assist the industry manage climate challenges. This indicates that the dairy industry has the best possible chance to ensure the development of policies, strategies and practical technologies that will allow the dairy industry to:

- › adapt (profitably, sustainably and in a timely manner) to a changing climate, and
- › contribute to emission targets in ways that are effective, efficient and internationally competitive.

### 7.3. Key past and existing investments

There has been a high level of previous investment in industry climate change adaptation programs including DA's *Confidence to Grow*, DPI Victoria's *Victorian Climate Change Adaptation Program*, numerous state government initiatives and the Australian Government Farm Ready Projects.

### 7.4. Priorities for future investments (RD& E activities) to deliver the outcome (including organisations that should be involved)

A conventional set of RD&E activities—based on individual science/technology projects or solutions, is not an appropriate response to delivering a complex outcome like ‘building confidence’. The consensus from the expert group was that whatever the scale of investment thought to be appropriate to deliver against this outcome, the investment must be now include elements of the following 4 ‘activity areas’.

#### B.1 Climate Change communication/education activities focused on:

- › Providing a dairy industry perspective on the issues associated with the suite of climate change issues, but without an overt focus that dairy farmers should believe in climate change
- › Clarifying that there are practical and proven strategies/options for dairy farms to adapt to current climate challenges and to prepare for likely future challenges—supported by case studies that show how individual dairy farmers are responding to their particular climate challenges in practical ways
- › Reinforcing the key messages from *Confidence to Grow*, that “managing climate variability is and always has been a big part of managing a farm” and “farm businesses that are efficient and profitable now are best placed, no matter what the future holds”
- › Providing on-going engagement and training of dairy industry advisers and service providers
- › Contributing to a wider, learning culture that enables individuals and the industry to expand their capacity and to continue building their future in an uncertain world.

**Organisations that should be involved:** Dairy Australia needs to take the lead, but in partnership with other groups, especially the State agencies (DPIV in particular), DAFF (through the Climate Change Research and Farm Ready Programs), Gardiner Foundation, State Farmer Organisations, Universities, milk companies etc.

## **B. 2 Development of adaptation and mitigation technology solutions that:**

- › Are industry driven towards practical options that can be integrated into profitable dairy farming operations to build resilience and flexibility.
- › Focus specifically on helping dairy farmers adapt to climate variability/climate change but recognise there can be trade-offs between business flexibility and productive efficiency.
- › Recognise that climate variability (not the slow, underlying climate change) is the primary management challenge and incorporate this understanding into practical tools.
- › Incorporate a cost/benefit analysis to enable farmers to make informed investment decisions that improve the sustainability of their business.
- › Recognise that adaptations to climate change are not a stand-alone activity but involve changes in the major farm management issues of feedbase, the herd, the people and the business structure.

**Organisations that should be involved:** The Commonwealth Government (through the DAFF Climate Change Research Program) as a primary funder with Dairy Australia, Gardiner Foundation, State Agencies (DPIV in particular), Universities and CSIRO.

## **B.3 Local/regional adaptation and mitigation projects that:**

- › Are driven by the needs of local/regional farmers and farmer groups.
- › Focus on immediate strategies, options and activities that can reduce vulnerability to climate variability/ climate change while contributing to other important on-farm goals such as productivity, efficiency, profitability or workforce gains.
- › Incorporate learning about climate, climate variability and climate change, in a way that is inclusive for all dairy farmers from climate change deniers to strong advocates for the scientific conclusions.
- › Demonstrate new adaptation approaches in tandem with other market and biological risks.
- › Foster collaboration between producers within a region, and with processors and service providers.

**Organisations that should be involved:** DAFF, DA, DPIV (and agencies in other states), UoM, RDPs, and milk companies are already investing in this area through Future Ready Dairy Systems and Climate Change Adaptation in the Southern Livestock Industries. The critical issue is the engagement of the key people who can make a difference in the local community.

## **B.4 Effective connection/translation mechanisms that:**

- › Focus on linking regional action groups and regional projects (activity area 3 above) with research teams (2 above) to promote two way information flows.
- › Specifically resource 'development' activities that 'translate' the technology development activities into practical tools, strategies and options for use in the local/regional activities.
- › Support leadership development within both the regional activities and the technology development projects to keep the industry at the forefront of climate change preparedness.
- › Harnessing new information technologies to make the connections/translations easier to establish and maintain.

*Note: The expert group recognised that while research is increasingly 'centralised', delivery of information around climate challenges must be highly localized. The group believed that there has historically been under investment in the processes needed to connect these two scales and assist with the essential 'translation'.*

**Organisations that should be involved:** All 'organization's involved in either R&D or in the local demonstration/ delivery of information to dairy farmers needs to have a say in how the process of linking/translating might work best.

## **7.5. Time frame for activities**

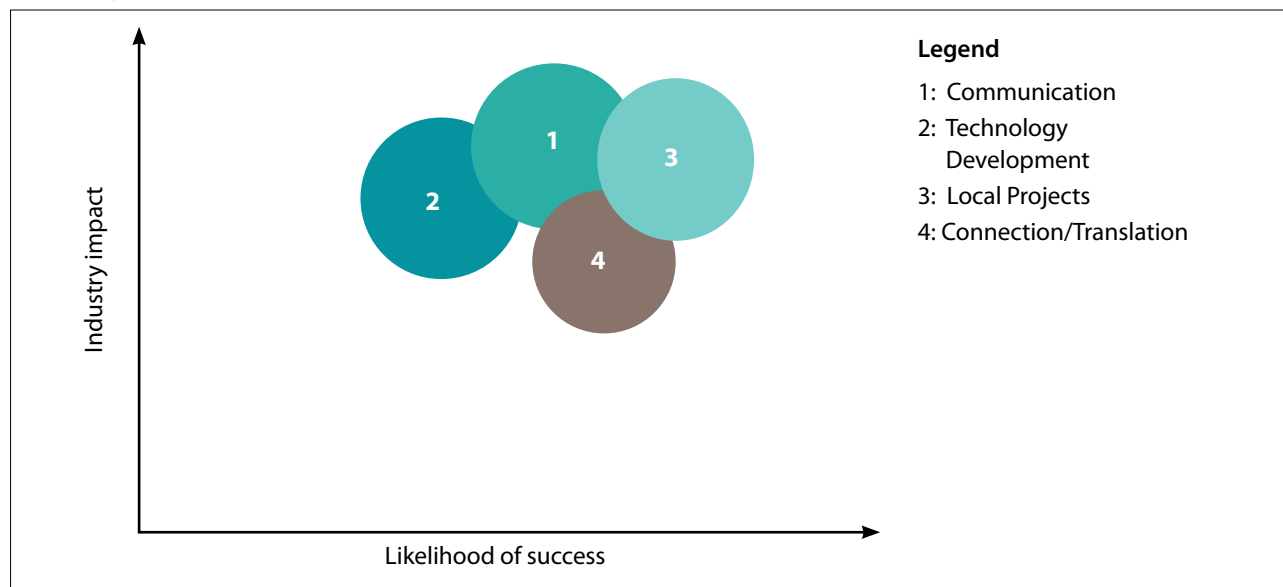
- ▶ Climate change communication and education activities aimed at providing a dairy industry perspective
- ▶ Development of adaptation and mitigation technology solutions
- ▶ Local/regional adaptation and mitigation projects
- ▶ Effective connection/translation mechanisms
- ▶ Within 1–2 years



## 7.6. Qualitative Ranking of impact and likelihood of success

### Impact vs Success

Figure 5. Example of a likelihood of success vs industry impact graph (size of the bubble indicates scale of investment needed within that activity area)\*



\* Estimations of impact, likelihood and scale of project are qualitative only and reflect the opinion of the Dairy Moving Forward expert working group

## 7.7. RD&E Capability (gaps and resources) for the Investment Priorities

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		A wide array of capabilities exists within the traditional dairy industry service providers if funding support is available. NRM has traditionally used a wide array of disciplines and providers.
Do these people and organisations represent the majority of prior learning in this area?		Yes, though refinement and improvement are needed to bring a strong focus onto the climate challenges. Translation and linkages between scales are historical weaknesses.
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		There are no guarantees, but the issue of industry confidence and how to build it was a major outcome from the wide scale consultation during the Confidence to Grow program.
Would the collaborators be able to provide diverse avenues for change?		Potentially, but strong industry leadership/coordination would be needed if diverse strategies, or diverse avenues were to be explored concurrently. It will not happen spontaneously.
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		Investment priorities 2 and 3 are currently resourced to the level implied in the outcome, but priorities 1 and especially 4, not well resourced.

## 7.8. RD & E priority activities currently underway

Industry is investing in projects which target several of these investment priorities; these are DPI Victoria's Victorian Climate Change Adaptation Program, numerous state government initiatives and the Australian

Government Farm Ready Projects. The industry Future Ready Dairy Systems and Mitigation and Adaptation in the Australian Dairy Industry projects are targeting all four key investment priorities.

## 8. Priority Outcome 3: Increased industry capacity to reduce greenhouse gas emissions

### 8.1. Background context

Improved management of methane and nitrous oxide emissions has direct benefits for the productivity and profitability of ruminant livestock production systems in addition to the public good benefits through reduced GHG emissions.

#### Dairy is a significant contributor to national greenhouse gas emissions

The Australian National Greenhouse Gas Emissions Inventory Report 2008 estimates emissions of greenhouse gas from the Australian dairy sector are equivalent to approximately 10% of national agricultural emissions or about 1.5% of national greenhouse gas emissions (assuming agriculture contributes 16%). The emissions are mainly from enteric fermentation (83.0%), direct N losses from faeces and urine voided to the soil and derived from manure management and from nitrogen fertiliser use.

#### Current abatement options are incremental but there is no silver bullet

Methane production per unit of dairy products is controlled by feed intake, diet composition, animal factors (cow longevity and maternal efficiency) and herd management strategies. The responses to dietary manipulation are variable (ranging from 5 to 25%) with some effects on animal performance (some increase milk production, others reduce production). There is evidence in beef cattle, sheep and dairy cows (currently very limited) that some animals produce less methane per kg DM intake. This trait may be heritable.

#### Measuring greenhouse gas emissions is difficult and costly

Measuring methane and nitrous oxide emissions is difficult, expensive and can be prone to high variability. Both greenhouse gases can be measured in the field using open path laser and FTIR spectrometry. More details studies of methane production can be achieved using open-circuit calorimetry and, more recently via an intra-ruminal bolus. Nitrous oxide emissions from

pastures are very difficult and expensive to quantify due to the high spatial and temporal variability in these emissions from dairy farms. These losses are small, but important in the overall greenhouse gas emissions output from a dairy farm. There are significant investments in Australia and internationally in projects to measure and model greenhouse gas emissions from different production systems. Examples include the Australian Government Climate Change Research Program and the Global Research Alliance on Agricultural Greenhouse Gases. These programs will report to national inventories. The industry has developed a tool, the Dairy Greenhouse Gas Abatement Strategies (DGAS) calculator, for dairy farmers to calculate the greenhouse gas emissions from their farming operation and to test different strategies to reduce those emissions.

#### There is a high level of uncertainty around future carbon policy settings

There is great uncertainty in the future of carbon policy settings in Australia and internationally. Despite this uncertainty, a carbon price seems inevitable and already some international food and beverage companies such as Unilever and Nestle are asking Australian milk processors to provide a carbon footprint for their products. The IDF (International Dairy Federation) has determined a standardised process for a carbon footprint or LCA, and this process is being used in an industry project that will provide national estimates of the carbon footprint of the major dairy products (fresh milk, skim and whole milk powder, butter, cheese, yoghurt).

### 8.2. Industry Needs and Strategies to Address the Outcome

In order to achieve an increased industry capacity to reduce farm greenhouse gas emissions, the approaches taken have to be carefully considered. There are currently no direct financial, market or political signals for dairy farmers to reduce greenhouse gas emissions. The strategy outlined here is to ensure that the dairy industry is well placed, with options and proven strategies that can assist the dairy industry actively reduce greenhouse

gas emissions when the scientific, community and political signals align. Against that uncertain background, the following strategies are needed.

- › **A primary focus on emission intensity** (reducing emissions per unit of product). This is industry's preferred position – i.e. to report on and reduce over time the emissions associated with the production of (say) a litre of milk. However, there are two challenges to this position - Australia has to report on and set reduction targets against total emissions, not emissions intensity; and many strategies may deliver reduced emissions per unit of product but lead to increased total farm emissions. Therefore, despite the industry's desire to focus on emission intensity and the importance of achieving that, the R&D approach must also include some focus on total emissions so that the industry can respond appropriately no matter what signals it receives.
- › **Development of better, less costly methods to measure greenhouse gas emissions:** If farmers are expected to reduce emissions, then some mechanism for verifying farm scale emissions is essential. Accurate data on emissions is important for the international and national inventories as well as for farm verification so this is an international issue. There are currently no practical or cost effective methods for methane or nitrous oxide emissions at a farm scale.
- › **Better quantification of greenhouse gases and emission reduction strategies including a focus on whole of system impacts:** The relative importance of different GHG sources in different farming systems is not well understood. There are two needs – the validation of short term abatement experiments and predictions for emissions from different dairy production systems, and an analysis of the interactions between soil carbon, soil water and nitrous oxide; forage quality and methane production. These studies must also include full economic analysis.
- › **Improved modelling capability:** One way of understanding whole of system impacts is to use modelling. There is a need for refinement of models to predict greenhouse gas outputs from different farming systems. There are a range of models available from simple annual time-step inventory type models (eg. DGAS), through to whole farm systems models (eg. DairyMod) and detailed component models (eg. Sub-daily time-step of ruminal methane production).
- › **Increased understanding of the options, the opportunities and the challenges in the carbon market:** This will enable farmers to make informed decisions about direct or indirect participation in the any carbon markets that are developed nationally or internationally. This might include carbon sequestration in soils, trees or the production/use of biochar. Improving energy efficiency is an immediate option for dairy farmers. It is something farmers can do now, without any 'emissions reduction' signals because energy (fuel and electricity) already has a price signal related to Renewable Energy Certificates (RECS) and there are strong indications that the price will be increasing over time.
- › **Communication and education:** It is important farmers and industry service providers continually build an understanding of climate change, greenhouse gas emissions, national and international policy developments, and progress towards practical and profitable greenhouse gas emission reduction strategies.
- › **An integrated approach to the climate challenges:** This is a traditional dairy industry strategy that maintains a collaborative partnership with Government to ensure dairy's voice is heard in policy development; integrates the challenges of climate change/greenhouse gas reduction into the plethora of uncertainties that contribute to farm business risk; works actively with other primary industries to achieve positive/collective outcomes; and takes an integrated and collaborative approach to resourcing research and development by forming partnerships with Government and other agencies.

### 8.3. Key past and existing investments

There are a number of RD&E initiatives being undertaken nationally that will inform planned investment in GHG reduction priorities under Dairy Moving Forward. These include:

- › NORP (nitrous oxide research program) focused on options to reduce N<sub>2</sub>O from Australian soils and coordinated by GRDC;
- › RELRP (reducing emissions from livestock research program) focused on reducing methane from ruminants and coordinated by MLA;
- › SCaRP (soil carbon research program, including the biochar research initiative) focused on understanding the national soil carbon picture, the impact of management and the options for sequestration. Coordinated by CSIRO.
- › MAADI (Mitigation and Adaptation in the Australian Dairy Industry) focused on demonstrating currently applicable technologies and developing the next generation of farm ready options. Coordinated by DA.

These current programs (apart from MAADI) are cross industry and focus on basic research in greenhouse gas production, mitigation and abatement/sequestration.

## 8.4. Priorities for future investment (RD&E activities) to deliver the outcome (including organisations that should be involved)

The consensus from the workshop of industry experts was that additional dairy RD&E resources should be applied to the following 4 'activity areas'.

### C.1. Measurement methodology

Strategies to reduce greenhouse gas emissions from dairy farms are currently limited by the lack of measurement methodology at small and large scales. There is a critical need for a rapid, cost effective method for measuring individual animal enteric methane production so as to enable the development of improved understanding of variation in methane production of animals and a wider evaluation of dietary and other mitigation measures. This work also links to understanding improved feed conversion efficiency by working at a sub-rumen, rumen and whole animal level. There is also a need for more accurate and lower cost methods for measuring and reporting nitrous oxide emissions. This activity area should encompass life cycle assessment to allow a full analysis of the potential impacts of abatement on a whole farm system.

**Organisations that should be involved:** Industry funders (DA and Gardiner), DAFF, Universities (Melbourne, Tasmania, Western Australia, Queensland), State Governments and CSIRO.

### C. 2. Quantifying dairy specific GHG abatement strategies

Currently the greatest knowledge gap is concerned with the estimation of direct and indirect N emissions (nitrous oxide). Potential research areas may include manipulation of N efficiency in the animal (aim to increase milk protein output and reduce urine N excretion), understand the relationship between soil carbon, soil water and nitrogen losses in dairy pasture soils, evaluate the potential to reduce nitrogen losses through management practices and /or inhibitors; and measure N<sub>2</sub>O losses from dairy effluent applied to pasture/crops.

In addition, the relationship between Feed Conversion Efficiency and enteric methane emissions is poorly understood.

**Organisations that should be involved:** Industry funders (DA and Gardiner), DAFF, Universities (Melbourne, Tasmania, Western Australia, Queensland), State Governments and CSIRO.

### C. 3. Evaluation of GHG emissions abatement strategies at an integrated systems level

There is need for full farm systems evaluations of different abatement options available for dairy production systems. Currently abatement strategies are mainly considered in isolation, whereas in reality, the interactions are likely to be large.

These evaluations should include measurement of carbon, methane, nitrous oxide and ammonia fluxes from pasture based dairy systems; the impacts of changing the feedbase, soil management, diet, and animal phenotype/genotype to provide long term data for DGAS, LCA and other tools, and; the interactions and implications for GHG emissions from climate change adaptation strategies.

**Organisations that should be involved:** Industry funders (DA and Gardiner), DAFF, Universities (Melbourne, Tasmania, Western Australia, Queensland), State Governments and CSIRO.

### C.4. An industry led communication and education program

An industry led communication program focusing on practical and proven strategies available for dairy farms to reduce greenhouse gas emissions under current 'conditions' that supports farmers to identify which strategies are best suited to their business. The program should also focus on providing on-going engagement and training of dairy industry advisers and service providers - recognising that new knowledge, new strategies and new policies are constantly emerging from farmers, from RD&E and from Government.

A second component of the communication activity should also be targeted at the wider community including policy developers to reinforce the key message that well managed, efficient and profitable dairy farms are clearly the farms best placed to face any future challenges including GHG mitigation.

**Organisations that should be involved:** Industry funders (DA and Gardiner) and service providers, DAFF, State Governments.

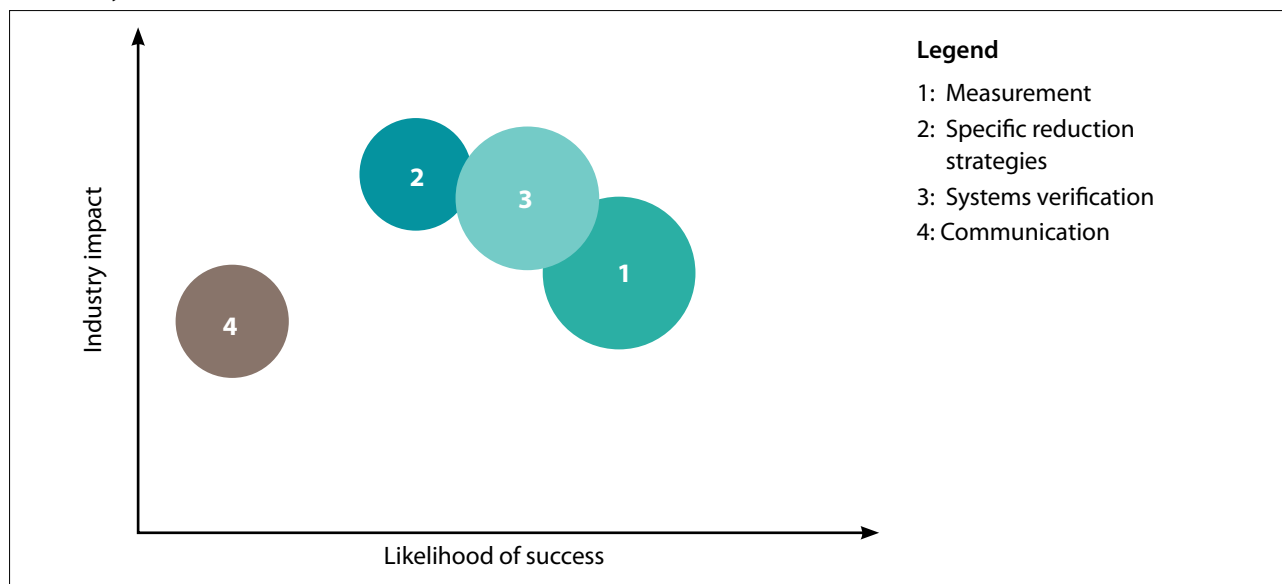
## 8.5. Time frame for activities

- ▶ Measurement methodology
- ▶ Quantifying dairy specific GHG abatement strategies
- ▶ Evaluation of GHG emissions abatement strategies at an integrated systems level
- ▶ An industry led communication and education program
  
- ▶ Commence within 1–2 years
- ▶ Commence in 2–4 years

## 8.6. Qualitative Ranking of impact and likelihood of success

### Impact vs Success

Figure 6. Example of a likelihood of success vs industry impact graph (size of the bubble indicates scale of investment needed within that activity area)\*



\* Estimations of impact, likelihood and scale of project are qualitative only and reflect the opinion of the Dairy Moving Forward expert working group

## 8.7. RD&E Capability (gaps and resources) for the Investment Priorities

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		A major effort is already going into the basic science of agricultural greenhouse gas emissions because of Commonwealth initiatives.
Do these people and organisations represent the majority of prior learning in this area?		Yes, though refinement and improvement are needed to bring a strong focus onto the specific dairy industry challenges. Systems level implications is an area of capability need.
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		Benefits for co-investors are not clear without policy signals.
Would the collaborators be able to provide diverse avenues for change?		Potentially if strong industry leadership is provided. However, this objective is not about change, but about preparing the options, strategies and industry preparedness for potential future needs to change.
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		Because there has been major DAFF funding into this investment priority, in the short term the capability is strong. Longer term challenges may face significant capability limitations if Commonwealth priorities change.

## 8.8. RD & E priority activities currently underway

There is a limited amount of investment currently underway in priority investment areas 1 & 2.



## 9. Priority Outcome 4: Long term sustainable use of nutrients through greater understanding of nutrient pathways

### 9.1. Background context

The loss of nutrients from dairy farms is both an economic issue for dairy farmers and an environmental 'problem' for the dairy industry. Understanding and better quantifying some of the loss (and therefore by default, capture) pathways is an important priority. Within the NRM&CC arena, there is a second nutrient focused outcome, *"Improved extension of nutrient management principles and practices to achieve a more rigorous objective approach to nutrient management at farm level"* which is focused on extension of good nutrient management practice.

Industry research has found the utilization of nutrients on dairy farms can be very inefficient, although there are variations in efficiency between farms suggesting opportunities to improve. Increasing fertilizer inputs, in particular N generally leads to increases in production of fodder for dairy cows, although this is not the case for all nutrients and all farming systems. To ensure nutrients are not a limiting factor farmers often apply more fertiliser than soil and tissue tests suggest is needed.

Excess nutrients such as phosphorous can accumulate in soil and be lost to surface and groundwater; while surplus nitrogen can end up in groundwater (through leaching), surface water (through runoff and shallow soil profile drainage) or the atmosphere (ammonia volatilization, nitrification and denitrification). Nutrient movement and concentration (feedpads, laneways, night paddocks and effluent treated areas) within the farm can result in nutrient 'hot spots' which have implications for animal health and off-farm losses. Improved recycling of N and P from urine and dung represents a significant but challenging opportunity for improved farm-level nutrient use efficiency.

#### Utilisation of nutrients has an animal scale, farm scale and catchment scale

Any program of work to optimize nutrient efficiency, in particular N efficiency should be developed in partnership with the Feedbase and Animal areas. For example assessment of new pasture/fodder crop combinations requires assessment of both economic and environmental performance (including GHG emissions). Another example is manipulating the diet to minimize loss of urinary N.

The factors influencing the pathways by which excess N is being lost off farm under Australian conditions are

not well understood. From an environmental viewpoint it is important for the Australian dairy industry to be able to quantify whether excess N is being lost as di-nitrogen, ammonia, nitric or nitrous oxide or ending up in surface and ground water as nitrate. Significant investment has been directed towards measurement of gas effluxes from dairy soil without consideration of the microbial community changes associated with these events. Soil carbon plays a significant role in both capture (N-fixing) and loss (denitrifying) pathways. Mechanistic understanding of the underlying functions leading to efflux events will inform management solutions.

#### Environmental standards

The "off site" impacts of nitrogen and phosphorus can include significant declines in water quality and other associated environmental impacts including potential threats to human and animal health. The health aspect of pathogens in water supply catchments is a key issue in some areas. Whilst pathogens from dairy effluent are not associated with nutrients they do leave farms via the same pathways.

Diffuse source nutrient regulation targeted at the dairy industry is limited to a few high risk catchments and is likely to remain so in the near future. There are existing standards/principles for nutrient/fertiliser management at an international level and these may be adopted by international companies purchasing Australian dairy products.

#### Quantifying the impact of changed on-farm nutrient management practices on the environment at the catchment scale is a major challenge

Nitrogen and phosphorus exports are a natural consequence of any plant or animal production system. However, the impacts of these exports depend on the complex nutrient mobilisation and immobilization processes occurring beyond the farm and the sensitivity of the ultimate receiving environment.

The dairy industry has made significant investments in catchments studies and the development of dairy catchment models. This work has helped build a better understanding of the off farm impacts of dairy practices on water quality. However there are still knowledge gaps in nutrient mobilisation and immobilization processes and the spatial and temporal variability of nutrient

exports from dairy systems. The recommendation from some members of the expert group was that the fate of nutrients off farm is extremely complex and relevant R&D should be left to other groups, for example the Landscape Logic research hub being funded by DEWHA. Dairy may most effectively benefit from improving its engagement with these groups rather than commissioning its own research.

## 9.2. Industry needs and strategies to achieve the outcome

### Integrated approaches

Project development should involve representatives from the NRM, Feedbase, Animals and Climate Change mitigation programs. Inefficient utilisation of nutrients can impact on animal health and performance, farm profitability, catchment health and greenhouse gas emissions.

### Whole farm systems perspective

Some nutrients are in limited supply (e.g. Phosphorus), others (e.g. Nitrogen) are intimately linked to high energy inputs for production and greenhouse gas emissions, raising long term issues associated with sustainability and efficiency. Improving the efficiency of nutrient use on dairy farms will require:

- Improved understanding of nutrient movement within the farm and nutrient loss pathways from a systems as well as a component perspective
- Identifying practices with the ability to reduce losses and increase production
- Industry 'best practice' application and management of nutrients being compatible with the long term sustainability of soil health.

### Awareness of possible regulatory requirements

Likely nutrient management reporting requirements at international, national, state and catchment scales need to be explored and understood to assist the focus of RD&E activities. For example in some areas, such as WA and QLD access to fertilisers and/or water may be linked to adoption of good practice nutrient management.

### Investigation of the role of soil microorganisms

Lessons on plant nutrient management and soil biology learned by other industries, particularly grain cropping, can have benefits for the dairy industry. The new sequencing technologies that are enabling unprecedented access to the 95–99% of the microbial community that can be cultured will vastly improve understanding of the specific roles of

soil bacteria, archaea, fungi and viruses in N fixation and P accumulation thereby adding significant value to the traditional chemistry based approaches to nutrient management. Existing and potential microbial inoculant products that maximize nitrogen fixation and phosphorus uptake, and microbial inhibitory products that block nutrient transformation pathways should also be explored to determine the extent to which they improve current best practice pasture/forage management practices.

## 9.3. Key past and existing investments

There has been significant levels of investment by industry to build knowledge about on and off farm nutrient management, examples include Phosphorous in Dairy Farms, Better Fertiliser Decisions, Accounting for Nutrients, Accountable Dairying, Montagu Catchment Study, DairyCatch, GipRip, Queensland Riparian Assessment, Brucknell Creek, Coastal Dairy Catchments, Understanding Dairy Catchments, Grazing Strategies to reduce Nutrient losses from Australian Dairy Farms, and Spatial and temporal modelling of water and nutrient flows from Australian Dairy catchments.

## 9.4. Priorities for future RD&E activities to deliver the priority outcome

*Note: a separate expert working group is dealing with improved extension of nutrient management principles and practices. Even so, this expert working group acknowledges the need for much of the suggested future R&D work below, to engage directly with producers through participatory on-farm R&D activities.*

### D. 1 Analysis of nutrient transformations,

**in particular N.** Undertake a critical review to identify the strategies most likely to optimize nitrogen use to achieve improved economic, environmental and animal health outcomes and subsequently develop and implement a RD&E program to investigate/ evaluate these strategies. The scoping exercise should involve research organisations and industries currently involved in nitrogen research both within Australia and internationally. This program of work may include the following aims:

- Conducting a whole farm system analysis of nutrient transformations, in particular N loss through runoff, leaching, volatilisation and de-nitrification.
- Establishing the biological potential for nitrogen use efficiency under Australian conditions.
- Assessing new pasture /fodder crop combinations that maximise nitrogen fixation and have the capacity

to utilise large inputs of applied nutrients (for example applied effluent, night paddocks). Such assessments should be made from a systems viewpoint.

- Evaluating nitrogen loss mitigants and alternative fertilizer forms to optimize economic and environmental performance (taking into account the way such activities may be integrated into dairy systems).

The emphasis should be on whole farm analysis with integration of soil, plant and animal science disciplines plus economic analysis. This cannot be achieved using small plot research strategies traditionally used by agronomists and soil scientists. Considerable installation of complex instrumentation will be needed to address the fate of N on farms, necessitating focused research and an emphasis on high N input systems.

**Timeframe for these activities:** 12 months for review. Research program may take 5–10 years. Climate will impact on findings, hence the need to conduct work over several years.

**Organisations that should be involved:** DPI V, I&I NSW and other states where expertise resides, CSIRO, University of Melbourne

**D.2 Microbial approaches for manipulating N and P** through plant, soil and animal systems, with a view to gaining a better understanding of the interaction between soil biological processes, fertiliser application and nutrient use efficiency. Proposed activities to involve a cross industry approach and should be strongly linked into Key Investment Area 1. The manipulation of microbial populations in the context of highly complex soil systems is a high risk strategy and the research investment needs to keep this in mind.

**Timeframe for these activities:** 2010–2020

**Organisations that should be involved:** State Government Departments (DPI Victoria, DEEDI, DAFWA, I&I NSW), Universities (Adelaide, Western Australia, Sydney, Western Sydney, Queensland, La Trobe), CSIRO Plant Industry, and RDCs (GRDC & MLA)

**Potential international collaborators:** University of California Berkley, Michigan State University, Colorado State University and Cornell University.

**D.3 Quantify the risks to the dairy industry from likely catchment, state, national and international regulatory requirements** targeting off farm nutrient loss over the next 5–10 years.

**Organisations that should be involved:** DA, milk companies, fertiliser companies, state NRM agencies including the EPA.

**D.4 A scoping study to determine knowledge gaps in the current understanding of where dairy nutrients end up in off farm sinks** and how these metrics change with changes in on-farm practices, from a sub-catchment, catchment and regional perspective. The scoping study should also articulate the likelihood of industry led research being able to successfully quantify off farm nutrient flows and sinks and identify areas for investment (if appropriate). It could also be used as a case for federal funding and/or participation by other industry sectors.

**Organisations that should be involved:** Expertise should include farm nutrient cycling and influence of management actions on this cycling and losses, those with expertise in stream and estuary nutrient dynamics. Organisations include DPI V, I&I NSW, CSIRO, TIAR, UWA

## 9.5. Timeframe for activities

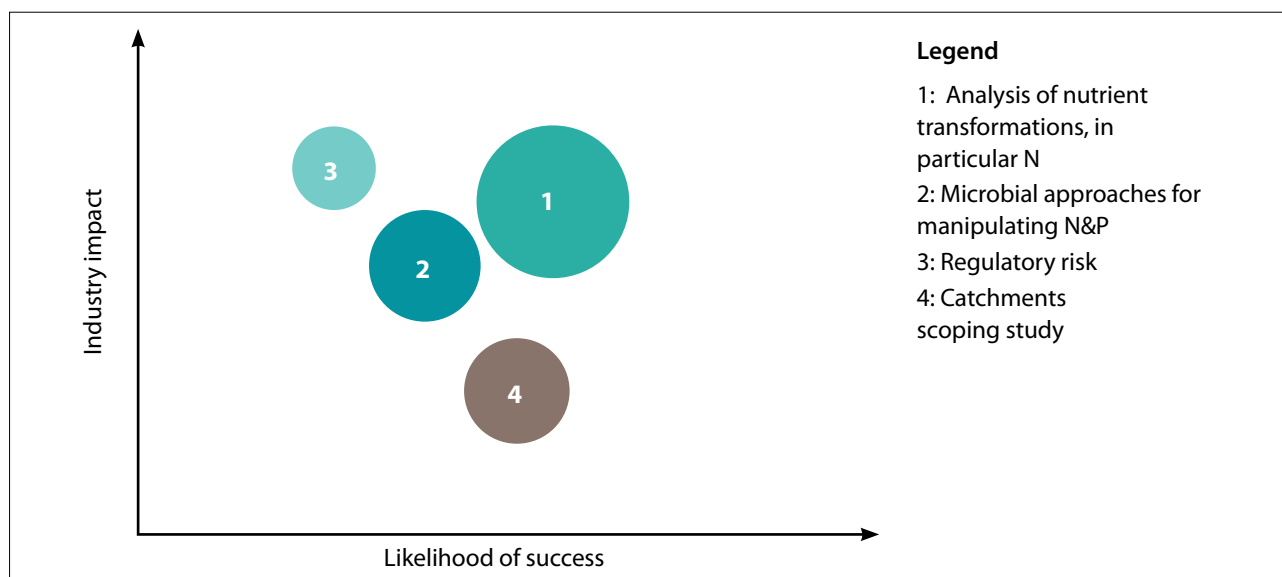
- ▶ Analysis of nutrient transformations, in particular N .
- ▶ Microbial approaches for manipulating N and P.
- ▶ Quantify the risks to the dairy industry from likely catchment, state, national and international regulatory requirements targeting off farm nutrient loss.
- ▶ A review to determine the knowledge gaps in the current understanding of where dairy nutrients end up in off farm sinks.
- ▶ Commence within 1–2 years
- ▶ Commence in 2–4 years
- ▶ Commence in 4 or more years



## 9.6. Qualitative Ranking of impact and likelihood of success

### Impact vs Success

Figure 7. Example of a likelihood of success vs industry impact graph (size of the bubble indicates scale of investment needed within that activity area)\*



\* Estimations of impact, likelihood and scale of project are qualitative only and reflect the opinion of the Dairy Moving Forward expert working group

## 9.7. RD&E Capability (gaps and resources)

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		There are a number of organisations with sufficient capability for key investment areas 1 & 4. Capability is being built in areas 2 & 3.
Do these people and organisations represent the majority of prior learning in this area?		Yes, for key investment areas 1, 3 & 4. The microbial work may involve working with other agricultural industries. The critical mass needed to undertake these activities is not located in any one agency. Activities should also be integrated into feedbase work.
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		For area 1 previous knowledge and investment together with reasonable capability ensures a good opportunities for successful outcomes. Area 2 is less certain, being more 'blue sky'.
Would the collaborators be able to provide diverse avenues for change?		Provided this priority is strongly linked in with Priority E: On farm nutrient management, as well as feedbase extension programs and industry NRM programs and DSS.
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		Expertise exists across a number of agencies areas but resources are less available. There is a lack of personnel with skills needed to undertake field-based and farming systems work. Skills limitations exist in soil microbial ecology of agricultural systems and technical guidance may need to be sourced from non-agricultural research sectors. There is little expertise within the industry in the area of regulatory risk.

## 9.8. RD & E priority activities currently underway

A scoping workshop for priority area 1 is planned for late 2010/early 2011. There is a limited amount of investment priority area 2.

## 10. Priority outcome: Improved extension of nutrient management principles and practices to achieve a more rigorous objective approach to nutrient management at farm level

### 10.1. Background context

For the dairy industry (and the individuals within it) to have confidence in the currently promoted soil nutrient targets and management principles there must be confidence around:

- › The reliability of soil, tissue and feed testing and the associated 'best practice' nutrient recommendations being provided by researchers, fertiliser companies, farm consultants and other relevant service providers
- › Industry 'best practice' application and management of nutrients being compatible with the long term sustainability of soil health
- › When advised to apply fewer nutrients (in the appropriate situation) it does not mean less dry matter production.

Soil testing is an important tool for advisers and farmers but there are issues to address, including:

- › A lack of a simple framework for soil mapping on farms. It is either "too complex" and hence not adopted or too simple and hence haphazard and incorrect
- › The quality of current soil testing methodologies resulting in high levels of variation between duplicate tests
- › Poor understanding by end users of laboratory testing accreditation schemes.

In addition to concerns around soil testing there is a lack of confidence in the Better Fertilizer Decision soil nutrient targets among some advisers, in particular their relevance at a regional level. This lack of confidence is compounded by the plethora of different nutrient advisory, diagnostic and decision support tools developed by consultants, DPI/State Departments of Agriculture and milk companies-including paddock scale nutrient mapping, nutrient budgeting tools, nutrient loss calculators and fertilizer rate calculators. The array of tools is a potential source of confusion for end users and most tools need to be supported by individual, professional advice at a farm level. There is a role for 'generic' tools but they need to be able to be modified to account for regional and sub-regional variables.

Farmers want to put fertiliser out, often regardless of soil test information or advice, because they see fertiliser as intrinsically linked to farm productivity and high soil fertility levels as an asset. There has been a limited utilisation of the win:win message by industry programs,

that when soil test levels are high reducing fertiliser will save them money and won't cut DM production. Proven nutrient management best practices should be linked with profit outcomes as well as environmental outcomes.

### 10.2. Strategies to address the outcome

Given the background issues listed above three key strategies underpin the activities needed to achieve the outcome. These are:

#### An agreed whole of industry consensus on nutrient management principles

The industry needs to reach a broadly based consensus on some simple key principles of good nutrient management practices based on credible science (e.g. on issues such as peak nutrient response curves; soil testing and interpretation of soil test results and nutrient budgets; definition of a healthy soil). To ensure whole of industry engagement with these principles this broad industry consensus must involve the farmers, fertilizer re-sellers, fertilizer companies, farm advisers/consultants and state extension agencies.

In response to the growing interest in biological fertilisers and the assumptions underlying the use of these products nutrient management principles should also include a clear definition of biologically healthy soils and if possible a full scientific evaluation of alternative "biological" and nontraditional fertilizers.

An additional area the dairy industry needs to agree on, and promote, is the fact that a high performing, profitable dairy farm that applies and manages nutrients as per agreed best practice, is not necessarily at odds with long term sustainability.

#### Increased industry confidence in nutrient management principles

Confidence must be built with farmers, that adoption of these new key principles in fertilizer and nutrient management will lead to financial and environmental benefits and will not result in a loss of pasture production, a major driver of profit. The key message will be that pasture production need not be compromised through a more tactical approach to nutrient management that takes account of environmental protection.

There needs to be industry acceptance that building industry confidence in best management principles requires a regional and district approach as



demonstrations in one region won't be seen as relevant in another region. The most appropriate activities to build confidence will be regionally relevant demonstrations and case studies involving credible producer and adviser advocates. Regional confidence building activities must include fertilizer sellers and operators.

### Investment in training, professional development and support for information sharing

Regionally tailored investment in training and professional development for advisers, consultants, fertilizer sellers and spreaders is essential. Without broad based industry understanding and support for industry best management principles, uptake of nutrient management best practice will continue to be impacted by lack of confidence in its applicability to local and regional conditions. To help build confidence in the training provided, delivery should foster connections between soil scientists, service providers and fertilizer sellers.

### 10.3. Key past and existing investments in this area

There is a strong history of industry investment to address nutrient management issues. Examples include *Better Fertiliser Decisions*, *Accounting for Nutrients and numerous regional National Landcare*, *Natural Heritage Trust and Caring for Our Country* funded programs targeting on farm change. The experiences from these programs suggest there are still some gaps to be addressed that could be met through the strategies and investments listed below.

### 10.4. Priorities for future investments (RD&E) activities to deliver the outcome (including organisations that should be involved)

The expert group suggested there were potentially five key investment areas required to deliver against the strategies to achieve the outcome 'Improved extension of nutrient management principles and practices to achieve a more rigorous objective approach to nutrient management at farm level'.

#### E.1 A national and regional network of simple test demonstrations/validation activities

The suggested mode of delivery is through existing farmer groups and industry programs. Demonstrations should engage the key "plant/pasture production achievers in each region/sub-region. Major fertiliser companies and resellers need to be involved in the set up and interpretation phases.

**Organisations that should be involved:** Consultants, DPI, fertiliser distributors, DA, appropriate dairy processors and regional development boards e.g. GippsDairy, WestVic Dairy and Murray Dairy.

#### E.2 A nationally agreed framework for the delivery of regional nutrient management extension

Historically nutrient management extension in the dairy industry has been funded through government NRM programs (NHT, NLP and CfoC). Design and delivery tends to be influenced by funding requirements and projects are not always linked in with existing industry activities or knowledge networks. The expert group suggested any national delivery framework should be based on common extension principles. For example:

- Demonstration activities reflect the questions farmers, farm advisers, dairy factory staff, and fertilizer sales representatives want answers to, before they will adopt/promote the new principles.
- Fertiliser companies and re-sellers are involved in the setting up and interpretation of local demonstration sites.
- Demonstration and training activities include benefit/cost analyses of new best practices in nutrient management and incorporate a profit focus as well as an environmental focus.

The development of the national design and delivery framework should be closely linked in with the development of national principles for nutrient management.

**Organisations that should be involved:** Consultants, DPI, fertiliser distributors, DA, appropriate dairy processors.

#### E.3 National agreement on a set of nutrient management principles together with a framework to integrate these principles into the decision making process

The expert group recommended the establishment of a technical committee made up of researchers, fertilizer industry representatives, farm advisers/consultants and farmers to initiate and oversee the development of the principles. The outputs should include principles around soil and plant sampling and testing; nutrient target levels and budgets; and soil biological health. There will also be a need for regional workshop(s) to reach consensus on these new nutrient management principles and to agree on the clear messages behind these principles.

**Organisations that should be involved:** Consultants, DPI, fertiliser distributors, DA, appropriate dairy processors.

#### E.4 Development and delivery of formal education on new nutrient management principles and practice

A key proviso is that resources and delivery must network with existing practical regional trials, case studies and extension to be “contexted”, not just “taught” from a fixed syllabus.

**Organisations that should be involved:** NCDEA, DPI, consultants, fertiliser distributors.

#### E.5 A national and regional nutrient management RD&E innovators network

Such a network would enable support, training, information exchange and consensus.

**Organisations that should be involved:** A working group similar to the expert group but with representation from a soil testing organization and DPI – those who deal with nutrient budgets.

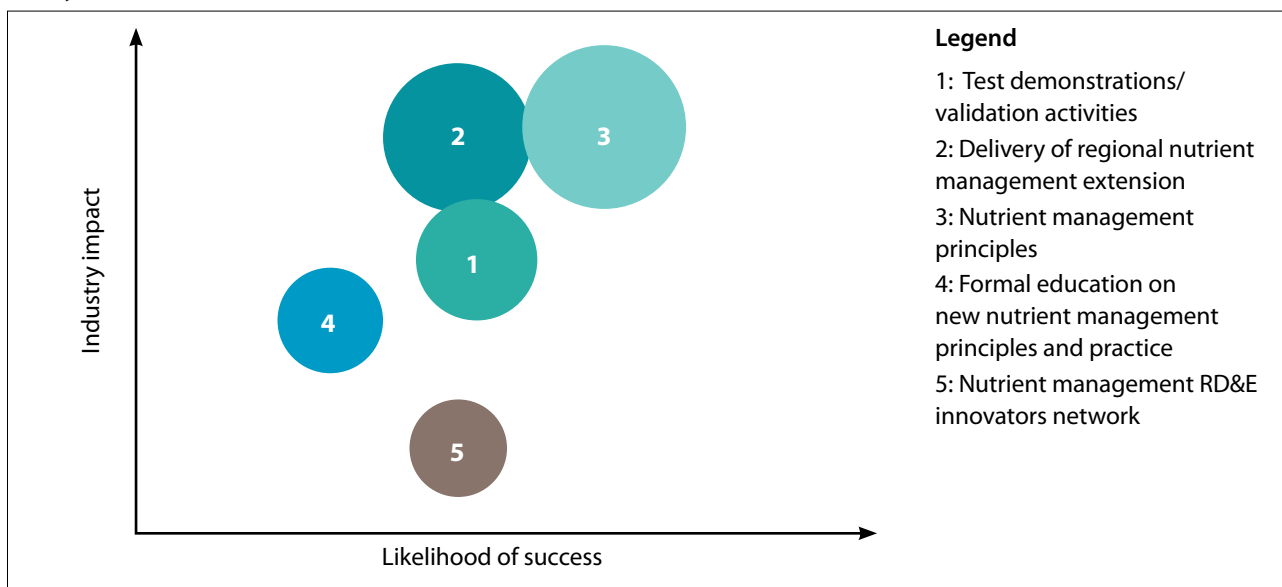
#### 10.5 Time frame for investment

- ▶ A national and regional network of simple test demonstration activities.
- ▶ A nationally agreed framework for the delivery of regional nutrient management extension.
- ▶ Development of national nutrient management principles.
- ▶ Development and delivery of formal education on new nutrient management principles and practice.
- ▶ Commence within 2 years

#### 10.6. Qualitative Ranking of impact and likelihood of success





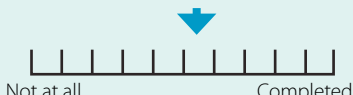
##### Impact vs Success

Figure 8. Example of a likelihood of success vs industry impact graph (size of the bubble indicates scale of investment needed within that activity area)\*



\* Estimations of impact, likelihood and scale of project are qualitative only and reflect the opinion of the Dairy Moving Forward expert working group

## 10.7. Capability available and required

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		There is sufficient capability but the outputs need to be specific and detailed.
Do these people and organisations represent the majority of prior learning in this area?		Yes, the issue maybe harnessing all the stakeholders. Ensuring the fertiliser industry is engaged will be critical to achieving the outcomes.
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		These activities will be well regarded by farmers. It will take a paradigm shift from all parties (those historically involved and who may need to operate differently and those who have not operated in this space before) to achieve successful outcomes.
Would the collaborators be able to provide diverse avenues for change?		Yes, but it will require support and lead coordination. There is a need to broaden the range so that it is not just demonstration sites; it is local extension programs at a farm level.
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		Some regions with a lack of good expertise may struggle to get this together. Resources will need to be re-allocated to this area. Some institutions whilst they have very capable personnel are not focused on extension and are unwilling to find resources for it. It will take a lot of nurturing to get a sustained shift.

## 10.8. RD & E priority activities currently underway

Investment in priority area 1 is planned and underway in two of the eight dairy regions.



## 11. Priority Outcome 6: Increased profit per unit of water use on irrigated dairy farms<sup>1</sup>

### 11.1. Background context

Major reductions in access to water have occurred in the past 10 years, especially in the lower Murray Darling Basin a significant focus for irrigated dairying. Some of these reductions have been due to prolonged drought, some possibly due to long term climate change and some due to ongoing government policy changes. In other dairy regions (e.g. Tasmania), there has been an increase in access to irrigation.

➤ **Decreasing availability of water:** Irrigated dairy farms differ considerably in the degree to which they are reliant on irrigation for fodder production. Irrigated dairy farms can range from those totally reliant on irrigation for fodder production to those using supplementary, targeted irrigation for fodder production. Historically, those farmers in the regulated irrigation districts (such as the southern Murray Darling Basin and Macalister irrigation districts) have been most reliant, generally producing the bulk of their feed from irrigation.

Most irrigation dairy farmers have made changes in fodder crop/pasture types or to the sourcing of fodder requirements off farm in response to changes in water availability. These changes are likely to continue in response to planned policy instruments such as the Murray Darling Basin Plan.

➤ **Irrigation is now mostly supplementary.** The dry spell of the last 10 years has been characterised by historically low irrigation allocations in the MDB and in this region farmers have had to adapt to become more like other irrigated dairy farms in Queensland, SW Victoria, Gippsland and Tasmania, using irrigation to supplement rainfall rather than as a production system in its own right.

➤ **Delivery systems need to be integrated with agronomic requirements.** For precision agriculture irrigation delivery systems must be able to deliver the amount of water needed, when it is needed. Knowing the agronomic requirements, combined with a more flexible delivery system allows farmers obtain the best use of their water.

➤ **Increased interest in alternative irrigation storage and delivery systems.** Reductions in access to water have increased attention on alternatives to traditional flood/ border check irrigation systems, including centre pivot or lateral move overhead sprays, and sub surface drip systems. The overall economic (farm profit) and water use impacts of changes in irrigation methods and changes in irrigation infrastructure for delivery and storage of irrigation water, have been analysed and reported, but are not able to be generalised, being dependent on a range of site specific factors including pre-existing farm, infrastructure and irrigation layout and standard, soil types, crops grown, farmer expertise and ability, reliability of water supply.

➤ **Increased reliance on utilisation of market instruments.** Reduced access to water has coincided with, or contributed to, increased reliance on utilisation of market instruments such as water trading and carry over—all designed to spread or better manage the risks associated with variable allocations but ‘fixed’ herd demand for forage. Farm planning decisions are now highly complex and ongoing in response to changing conditions, involving trade-offs between growing or buying fodder, buying, selling or storing water, and expanding or reducing milk production.

➤ **Use of irrigation scheduling varies widely.** Nationally, irrigation scheduling ranges from calendar based scheduling, to “rule of thumb” scheduling based on experience, to those who utilise objective measures of soil moisture and knowledge of crop growth stage specific water requirement to schedule irrigation. It is estimated that less than 5% of irrigated dairy farms in northern Victoria and southern NSW, where water ordering has historically required 4 days notice, use objective measures of soil moisture and crop growth stage specific water requirement knowledge to schedule irrigation. With system modernization and the promise of water deliveries at short notice, this situation may change rapidly. Use of objective, data based scheduling systems is much higher in areas such as SE South Australia and QLD.

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1. This section is the least well developed and requires more cross industry consultation as the potential impact of the MDB plan is clarified.



## 11.2. Industry needs to enable achievement of the priority outcome

- › **Development of and research into farming systems that are more suited to both reduced water supply (rain and irrigated) and to a more variable water supply.** These systems may involve new pasture/crop types, require new management skills, different labour needs and different grazing management and ration formulation management programs.
- › **Increased understanding of crop/pasture water requirements.** More information is needed on the water requirements of different crops/pasture types on different soil types, the balancing of stored soil moisture and both rain fed and irrigation supply, and, in particular the economic trade-offs between productivity and water deficit.
- › **Improved seasonal forecasting and associated decision support tools.** Farmers and advisers need access to better climate forecast information and the systems or tools to integrate this with improved knowledge of plant water use and soil moisture status to more tactically schedule irrigation frequency and volumes.
- › **Greater integration of the application system with water management for agronomic requirements.** The biggest gains will come from being able to improve the performance of both systems in concert. This will require a greater emphasis on designing systems that can deliver water in the right amount at the right time. Determining agronomic requirements will involve the use of crop modelling combined with soil moisture monitoring and weather forecasts.
- › **Better understanding of the economic and productivity opportunities associated with upgraded irrigation delivery infrastructure.**
- › **Access to training and support in new management skills and tools.** Reduced water availability and the 'unbundling' of water means farmers are required to make decisions in a more complex and volatile environment. Farmers need to have the capability and intent to manage total water use, water losses and impacts on the farm business, using standard metrics, across a range of farming systems, regions and soil types. The range of skills required includes planning the herd diet to account for a variety of feed sources over the season; managing contracts and labour; evaluating new cropping and irrigation systems; and using the water market and carry-forward options to best advantage. There needs to be an increase in farmer access to skilled advice through training and

professional support on profitable irrigation system design, management and performance monitoring.

- › **An industry water performance monitoring program.** There is a need for industry managed, measurement systems of water availability, application, use and losses. Farmers can then benchmark their performance against industry data.
- › **Confidence that government water policy will not keep changing.** Farmers are looking for certainty around water policy so they can plan for the future and not be subjected to on-going changes in water availability.

## 11.3. Key past and existing investments

There have been significant levels of previous investment in irrigation RD&E, examples include the *Feasibility of Subsurface Drip Irrigation, Efficient Irrigation Technologies to Match Soils and Dairy Farming Systems, the QDO WUE program, DEC Water workshops, Helping Dairy farmers Secure Their Water Future, and more recently Evaluation of High Flow Surface Irrigation within the Murray Dairy Region and Linking Farm and Catchment Programs to Irrigation Modernization.*

## 11.4. Priorities for future investments (RD&E activities) to deliver the outcome (including organisations that should be involved)

It is noted that the suggested R, D & E investments, below, are concepts only at this stage. They have been derived by the expert working group from the industry needs analysis above but require further detailed industry consultation prior to development of prioritised R, D & E projects. Project development should involve representatives from the Feedbase and Climate Change adaptation and mitigation areas.

### F.1 Identification and research into new dairy farm irrigation delivery and water management systems that:

- › align with new pasture/cropping systems
- › take advantage of new regional irrigation infrastructure
- › account for more limited and more variable water supplies
- › allow for precision 'delivery' of water
- › capitalise on learning's from other industries, e.g. use of soil moisture monitoring, remote sensing, precision irrigation, automation, etc
- › do not constrain future options.



This area of work will draw on the experiences of farmers that have already been heavily impacted by reduced water availability. A key component will involve measuring and reporting the changes in farm profit and changes in water use on a range of farms which have adopted changes in infrastructure, irrigation methods, and crop and pasture systems.

**Organisations that need to be involved:** Farm consultants, Irrigation service providers, Farmers, Water Authorities, State Government Departments, DA, Gardiner Foundation, milk companies, NRM bodies, NCDEA, Universities, other irrigation industries and the ADIC.

**F.2 Development of crop modelling tools that can be used in a predictive sense,** linking soil moisture monitoring and weather predictions to enable crop/pasture water requirements to be more accurately estimated and managed.

**Organisations that need to be involved:** Farm consultants, Irrigation service providers, Farmers, Water Authorities, DA, State Government Departments, Gardiner Foundation, milk companies, Universities, and other irrigation industries.

**F.3 Economics of investment in new on-farm irrigation infrastructure and irrigation methods,** e.g. fast flow or spray, for a range of crops and soil types and under a range of potential future scenarios for climate, milk price, input costs/availability, carbon tax etc.

**Organisations that need to be involved:** Farm consultants, Irrigation service providers, Farmers, Water Authorities, State Government Departments, DA, and Universities.

**F.4 Improved understanding of the economic role of water in a farm systems context.**

Outputs to include a farm management planner/scenario explorer that can:

- assess crop production and profit marginal responses to balancing rain fed and irrigated water supply, including the options of (buy, sell, transfer, use, annual or perennial, pasture or crop, autumn or spring)
- maximise a range of business objectives, e.g. given a set of circumstances and future price and climate scenarios, what should I do next in order to maximise profit/minimise risk/limit losses/ retain equity etc

**Organisations that need to be involved:** Farm consultants, Irrigation service providers, Farmers, Water Authorities, DA, State Government Departments, Gardiner Foundation, milk companies, NRM bodies, NCDEA, Universities, other irrigation industries, and the ADIC.

**F.5 Development and delivery of training and support in the new skills required to manage irrigation systems with a more variable and tradable water supply.** This training should be targeted at both farmers and service providers and could incorporate formal training through the NCDEA. Professional training targeted at service providers should be based on those skills/services that can best add value for farmers.

**Organisations that need to be involved:** Farm consultants, Irrigation service providers, Farmers, Water Authorities, State Government Departments, milk companies, NCDEA, and Universities.

**F.6. Development of nationally agreed water use benchmarking approaches together with a framework to integrate these approaches into the farm decision making process.** This activity should be linked in with the pre-farm gate sustainability reporting framework. Whilst the initial focus should be on benchmarking that adds value to farmers the same data maybe relevant for industry level reporting against sustainability indicators.

**Organisations that need to be involved:** Farm consultants, Irrigation service providers, Farmers, Water Authorities, State Government Departments, milk companies and the ADIC.

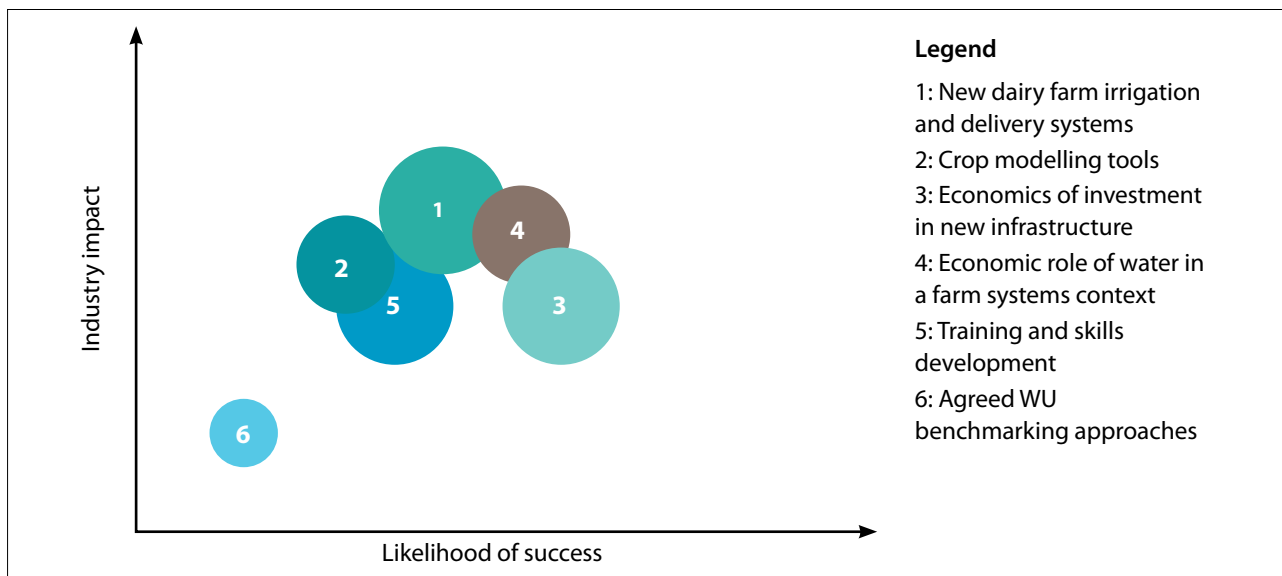
## 11.5. Time Frame for activities

- ▶ Identification and research into new dairy farm irrigation delivery and water management systems
- ▶ Development of crop modelling tools that can be used in a predictive sense
- ▶ Economics of investment in new on-farm irrigation infrastructure and irrigation methods
- ▶ Improved understanding of the economic role of water in a farm systems context
- ▶ Development and delivery of training and support in the new skills required to manage irrigation systems with a more variable and tradable water supply.
- ▶ Development of nationally agreed water use benchmarking approaches together with a framework to integrate these approaches into the farm decision making process
- ▶ Commence within 1–2 years
- ▶ Commence in 2–4 years
- ▶ Commence in 4 or more years

## 11.6. Prioritising the potential investment areas: Qualitative Ranking of impact and likelihood of success

### Impact vs Success



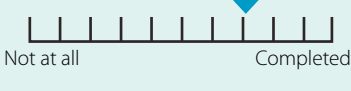
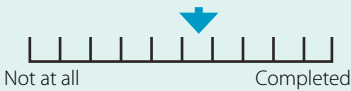

Figure 9. Example of a likelihood of success vs industry impact graph (size of the bubble indicates scale of investment needed within that activity area)\*



\* Estimations of impact, likelihood and scale of project are qualitative only and reflect the opinion of the Dairy Moving Forward expert working group



## 11.7. RD&E Capability (gaps and resources)

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		There is sufficient capability among both the public and private sectors for areas 1&2, but less capability around the economics of water in a farming systems context.
Do these people and organisations represent the majority of prior learning in this area?		Yes. Some of these activities should be integrated into the feedbase and farm business systems activities.
Is it clear that an investment in this area will provide benefits and outcomes for the co-investors?		Investment in areas 1, 3, 4 and 5 will be well received by farmers. Farmers are looking for information that can help them make decisions in response to reduced water availability and changes in irrigation delivery systems. There is far less certainty around areas 2 and 6. Dairy farmers have a history of not using crop modelling tools and many already exist. At least half the group felt WUE benchmarking would be a waste of time although some acknowledged the potential link with sustainability reporting.
Would the collaborators be able to provide diverse avenues for change?		The challenge is finding collaborators able to consider issues from a whole of farming systems perspective (including the economics). The complexity of dealing with water within a farm system means that the ability of any one individual to put all of the decision making information together is really challenged. Service providers may need to consider a team approach to be able to deal with the farm system connectivity required to assist farmers to make decisions about use of water.
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		Investment in this area, particularly in the area of skills development and training (of both service providers and farmers) has been declining in recent years. Resources will need to be re-allocated to this area if these activities are to be implemented, particularly in area 5. There is a lack of capability in area 4.

## 10.8. RD&E priority activities currently underway

An R&D activity investigating the economic performance of HI FLOW irrigation has recently commenced (this will deliver against priority areas 1 & 3).



# DAIRY MOVING FORWARD

People

## PEOPLE RD&E STRATEGY



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Karen Baum	(Pembroke consulting)
Patten Bridge	(Murray Goulburn)
Peter Carkeek	(GOTAFE)
Natalie Collard	(Australian Dairy Farmers)
Anne Crawford	(Rural Innovation Research Group, University of Melbourne)
John Dalton	(WestVic Dairy)
Paul Ford	(Gardiner Foundation)
Mik Harford	(Fonterra)
Tracey Harper	(DPIV)
Chris Hibburt	(The Vet Group)
Kerry Kempton	(NSW DII)
Barb King	(Rural Innovation Research Group, University of Melbourne)
Ruth Nettle	(Rural Innovation Research Group, University of Melbourne)
Robert Poole	(Murray Goulburn)
Kate Randall	(Gardiner Foundation)
Penny Shaw	(DPIV)
Cameron Smith	(Farmanco)
Mark Smith	(DairyTas)
John Verstedden	(GippsDairy)
Neil Webster	(Fonterra)
John Weichert	(Dairy Australia)



## 1. Executive summary

The Dairy Moving Forward People RD&E Strategy has been designed to ensure that people issues are not a constraint to wealth creation and industry resilience. A big part of the intent is having dairy farms that are still in business in the years to come and newcomers willing to invest in the industry.

The vision over the next 5–10 years is that:  
*People are recognised and developed as the key driver of sustained farm business success.*

This objective is based on the premise that it is human and social capital that drives the transformation of resources to economic capital. A farm business is shaped by the way decisions and plans are made for its future, technologies are adapted, and risks and uncertainty are managed. In short, farm systems are chosen, resourced and implemented by people.

The focus of the People Strategy is the people who manage farms, work on farms (in paid or unpaid roles) and provide services to farm.

Many improvements are needed in the industry to assure sustained business success on dairy farms. The following must become the norm, not the exception:

- › Farms are able to attract and retain the people they need.
- › Farm owners and managers have the motivation, skills and confidence to manage the people in their farm businesses.
- › Farms have a low business risk around ‘people-issues’.
- › Farm consultants support quality decision-making around development of a farm business strategy that incorporates people considerations.
- › Farm owners have options and plans for transition of management roles or farm assets and when they no longer want to run or own their farms.
- › The Australian dairy industry has effective workforce planning and action processes operating regionally and nationally.
- › Dairy industry programs have people as the focus when designing ways of operationalising technology.
- › Farmers actively pursue health, safety and well-being for themselves, their families and staff and can easily access the services they need to achieve this.
- › Local communities in dairying regions continue to be vibrant.
- › The industry has the leaders, governance and understanding it needs to effectively influence public policy and manage collective investments.

The Expert Group believes the industry objective can be achieved through five interdependent sub-strategies (themes):

1. **Farm business strategies (around people):** to ensure that farms have a people perspective in their business strategies, including their succession plans.
2. **Farm workplace change:** so that farms are better equipped to attract and retain the people they need and have low business risk around their people resources.
3. **Dairy ‘workforce development’ (everyone on farm and service providers):** so that the industry has effective workforce planning and action processes, regionally and nationally.
4. **Farmer well-being in supportive communities:** to ensure the industry and its people are supported by local communities that are vibrant and self-determining.
5. **Dairy leadership development:** to ensure that the industry has the leaders it needs.

A first step in this new area is to make the value proposition for taking action apparent.

Each theme has a number of priority areas for action.

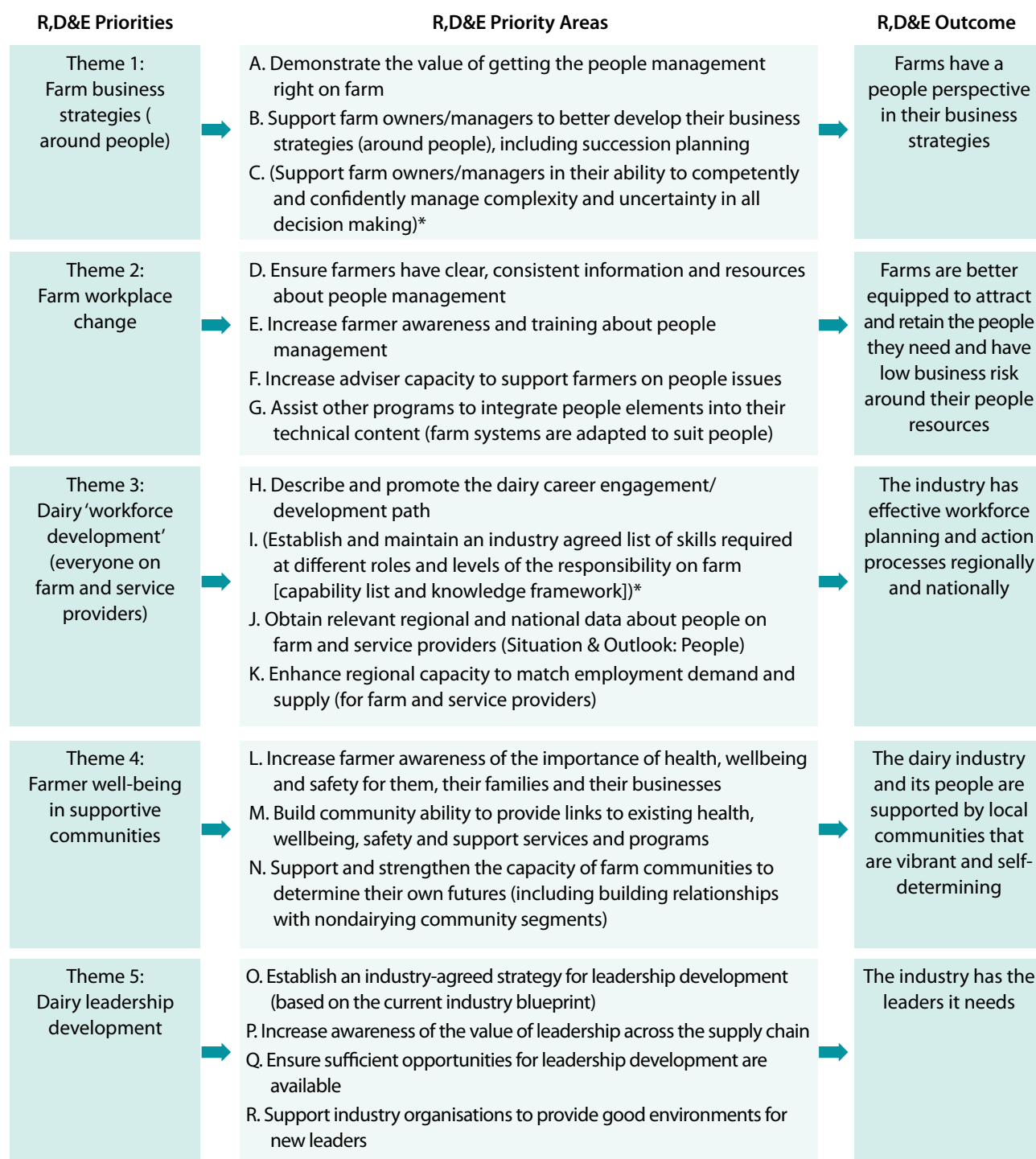
Each of these priority areas requires a program of work. Some are already well planned and underway. Others will need new initiatives. There are many points of interaction between these priority areas and also with other broad strategy areas—particularly the Farm Business Management strategy and the National Training Framework (delivered through the NCDEA).

Much of the People Strategy is in the Development and Extension/Education parts of the Dairy Moving Forward spectrum, but there is still a sizeable Research element needed. This includes articulating the value of acting in this area, better understanding what influences farmers’ transitions (entry, development and exits), testing ways of putting the principles of regional workforce planning into action, exploring methods of enhancing farm safety and research into the issues involved in providing effective support for rural communities.

The ‘people’ domain is a relatively new area of investment for the dairy industry having come to the fore over the last decade. The annual spend is estimated to be between \$2–3 million (based on the existing programs described as part of this strategy development). There is enormous potential for ongoing synergies providing

Figure 1. Priority areas for further Research, Development & Extension /Education investment

People are recognised as the key driver of sustained farm business success



\* with other programs

there is a whole-of-industry strategy and leadership group guiding the effort. The Expert Group believes that the current total investment (the 'size of the petal') will need to be increased to achieve the outcomes needed to deliver the vision.

RD&E/E needs to keep pace with the changes that dairy farmers face if the industry is to help them have the confidence, skills and information to make dynamic decisions—with people capacity at the core.

## 2. The People Strategy

'People' is one of the five strategic RD&E/E priority areas under consideration as part of the Dairy Moving Forward initiative to create a profitable, internationally competitive and sustainable dairy industry.

People are **the** key driver of sustained farm business success. It is important to describe the scope of the people portfolio given that "everything has people in it":

- › In essence it is about enabling farm businesses to achieve benefits from improved people productivity and well-being necessary for sustained business success.
- › All elements of the strategy are pre-farm gate (as per the terms of reference), but many elements involve developing an environment that enables them to be achieved.
- › It is much broader than Human Resource Management and Farm Business Management (although it incorporates the former and has strong links to the latter).

This People Strategy is bounded, it is NOT about:

- › The formal or informal training needs of people on farms across all the other management areas. The issues of skills audit, learning and assessment are relevant for all the Dairy Moving Forward portfolios ('petal' areas).
- › Assessing the capacity of the private service sector to support the demands of all the other portfolios .
- › Assessing the people needs (for example scientists or extension personnel) of the RD&E/E strategies in the other portfolios.

These are all important but separate considerations.

The People Strategy is fundamentally about the people who manage farms, work on farms (in paid or unpaid roles) and provide services to farm. Although the people on farm are the focus of the strategy, development of different program elements will involve various dairy organisations (peak industry bodies, dairy processing companies etc) as well as the public and private service sector, community groups, rural counsellors and social researchers.

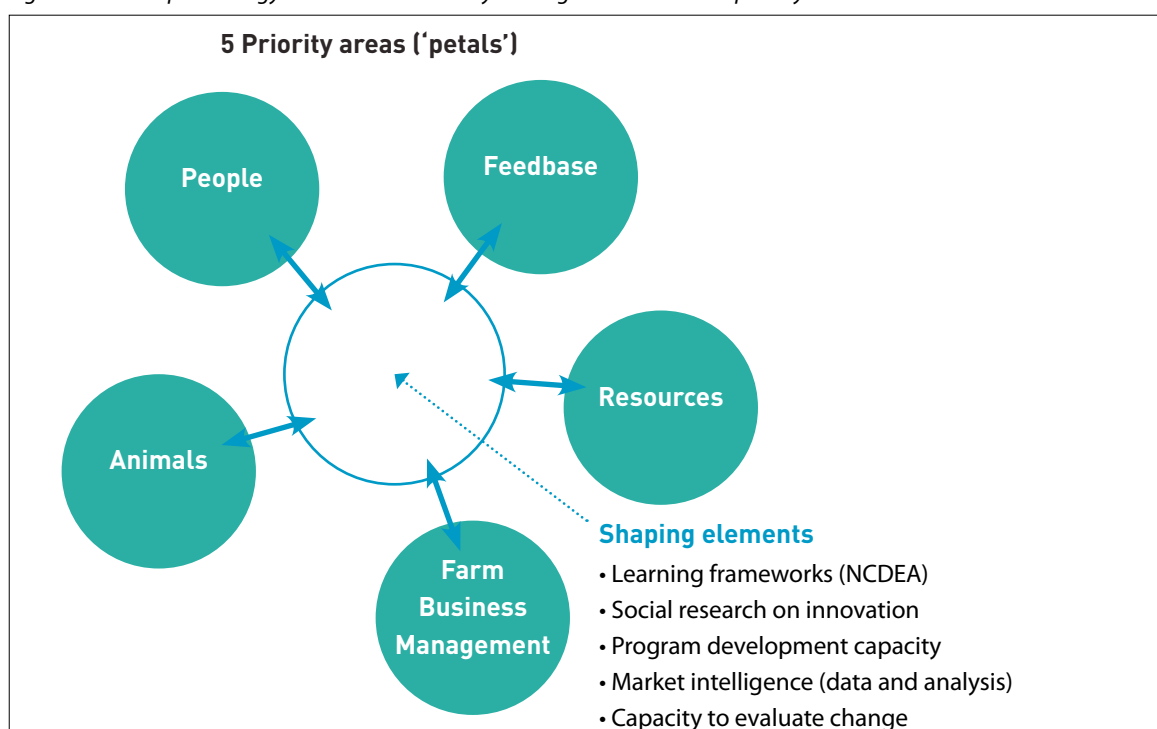
Development of this Dairy Moving Forward People Strategy has helped align activities of current investors in this area. A list of current and recent projects is presented in this report and it is estimated that these represent a current annual collective investment of between \$2–3M.

This report broadly describes the nature of the space in which the expert team believes the industry should be working over the next 5–10 years.

Its content has been based on 1-on-1 consultations with representatives of industry organizations, discussions at two Dairy Moving Forward expert group meetings in July and August 2010 and comments following presentations to the Industry Education Steering Committee (9 Sep 10), the Dairy Company senior managers meeting (20 Sep 10), the Dairy Australia Executive Leadership Team, The People in Dairy Core Group (7 Oct 10) and the Dairy Moving Forward Steering Committee (5 Aug 10, 28 Sept 10).

*1 The many questions around workforce development of service providers are a whole-of-industry issue: What is the capacity in the regions? What is the supply? Who determines the qualifications and skills that are needed? And is there sufficient demand to maintain currency?*

Figure 2. The People Strategy is one of the five Dairy Moving Forward RD&E/E priority areas



### 3. Why invest RD&E/E in having a People Strategy?

Farm systems are chosen, resourced and implemented by people. It is human capital and social capital that drives the transformation of resources to economic capital.

Concerns in this domain have been identified for over a decade. In 2001 Dairy Employment for the Future<sup>2</sup> began in response to employment issues in the industry but was overshadowed by the drought in the following years. In 2004 “people issues” around labour, succession and work-life balance came up time and again in the 2,000 “Taking Stock” consultations that assessed the health of farm businesses. By 2005 a national RD&E priority-setting process<sup>3</sup> formalized the need for strong farm business culture, better management skills, efficient and adaptable farming systems, and higher satisfaction and retention of people in the industry.

People enable the value of all other resources to be realized—and should be considered at the outset. Yet a lot more is known about the cows, milk, pastures and debt levels on farms than is understood about people capacity.

The vision of the People Strategy over the next 5–10 years is that people are recognised and developed as the key driver of sustained farm business success. The strategy is being designed to ensure that people issues are not a constraint to wealth creation and industry resilience. A big part of the intent is having dairy farms that are still in business in the years to come and newcomers willing to invest in the industry. It is likely that greater investment in this area will be needed to achieve this industry vision.

The Australian dairy industry is founded on a collective of 7,400 small to large individual farm businesses. The industry exists because it consistently produces good quality product at a competitive price, although this advantage has been eroded in recent years by the inability to rely as much on pasture-based feed systems.

Over the last decade farm businesses have had to survive uncertainties around the availability of key resources (water, grain then fibre), associated rises in the costs of inputs, then a reduction in income (reaction of international markets to the global financial crisis). As the business of dairy farming escalates in complexity this takes much more than technical expertise in milk production.

*“the vast majority of irrigators in the basin are smaller family enterprises, sometimes they make a good living, but much of the time they’re battling the seasons, the overdraft and commodity prices. They work hard and they’re not getting rich”*

—Judith Stubbs, Stock & Land interview, 13/9/2010

Many enterprises have not survived with farm numbers decreasing by about 40% since 2000. The remaining farms have increased in herd size (from 170 to 260 cows) and many are making major changes to their production systems. Almost all dairy farms (98%) are still family-owned businesses, with 15% as sharefarmers.<sup>4</sup> As herds have increased in size this has placed pressure on their work-life balance.

One response to the increase in herd size has been a profound increase in the proportion of farms employing people other than family, moving from ~30% in 2004 to ~70% by 2009. Dairy farms typically have 2–5 people working in the business.

**Table 1. Size of farm workforce<sup>5</sup>**

Number people	1	2–5	6–20	21–50
Herds	26%	63%	10%	0.5%

A lot of dairy farmers have relatively little personal experience as employees or employers. The need to enable farmers to better manage industrial relations and other legislative requirements and be more confident to employ were also seen as priorities for collective investment in the farm sector priority-setting exercise in 2005<sup>3</sup>. In 2006 about 4% of dairy farmers had participated in training in human resource management.

Almost 60% of dairy farms have attempted to fill a vacant position over the past five years and just over half of these farms had difficulty finding the right person.<sup>6</sup> One-quarter of these farmers said this resulted in a negative effect on farm performance. Getting suitably skilled and committed people was not such an issue in the past when many farms were passed on to the next generation and the up-and-coming young farmers learnt the skills and practice of dairying from their family.

The population of people who work on farm has become much more dynamic. Of the 25,000 people estimated to work in the industry, almost one-sixth of them (3,800) were recruited to farms during the past year<sup>4</sup>. Staff turnover alone is very costly because of the expense of recruitment and training, loss of expertise and pressure placed on the remaining people; with estimates ranging from 50–150% of the employee’s annual salary, this is at

2 Dairy Employment for the Future: the strategy, Australian Centre for Industrial Relations Research & Training, University of Sydney (an initiative of the UDV sponsored by WestVic Dairy and funded by the Geoffrey Gardiner Foundation), July 2004

3 Australian Dairy Industry Priorities for Collective Action for the Farm Sector, November 2005

4 Dairy Australia National Dairy Farmer Survey 2010

5 Dairy Australia National Dairy Farmer Survey 2008

Table 2. People input on dairy farms

	Average of 71 farms across Victoria (Dairy Industry Farm Monitor Project 2010)	Range from over 200 farms in south eastern Australia (Red Sky)
Cows milked per full-time equivalent (50 hours)	94 cows/FTE	<60 to >200 cows/FTE
Labour and management costs per cow	\$634 per cow	<\$300 to > \$800

least \$30 million dollars worth if 2,000 of the positions above are replacements at the most basic level (at say \$15,000 of costs per person).

The benefits of “getting people issues right” around sourcing and deployment of the workforce in the farm business can be significant. Conservative estimates from modeling in 2008 suggested that productivity and profitability improvements alone can mean as much as \$200/cow profit on some farms. This becomes a sizeable figure industry-wide: for example it is worth \$52,000 for a farm of 260 cows, and ~\$80 million per year to the industry if achieved on one-in-five herds.

There is a wide range in the people input on farms, but it is impossible to make a judgment on the significance of these figures alone, because the interpretation for each farm requires the context of the farm system involved, its sustainability (as a business) and the reward it generates.

It is difficult to do anything but a simplistic estimate of the benefit-cost of people interventions as few of the contributing factors (a healthy workplace culture, good working relationships etc) are measured. But the risks of not getting it right are highly visible: seen as premature exit of dairy farms, people and investment from the industry. Farm profitability, a smooth easy-to-run operation and the health and well-being of its people are incentives for owners of dairy farms to expand.

Traditionally growth of a farm business has relied on individuals and long working hours. Research in 2000 in Gippsland reported work hours of owner-operators as an average of 59 hours per week for 49 weeks.<sup>8</sup> In 2008 owner-managers self-reported working an average of 68 hours per week, 50 weeks a year<sup>5</sup>, which is almost

double the 1855 hours annual average worked in Australia, the country with the highest annual working time in the developed world.<sup>9</sup> But this approach is hitting a ceiling: the long hours displace time with family and limit involvement in external pursuits, significantly reducing satisfaction with dairying for more than two-thirds of these people. For many farms there must be a change to the way things are done.

Individual farms must position themselves well to attract and retain people they need. Effective deployment and retention of staff occurs in workplaces that offer decent work (farms that have good workplace culture, work-life balance, recognition and reward).

Farms are also part of the broader community and their appeal as workplaces will be influenced by regional and national factors. When unemployment levels are low, skilled people have many career choices. Individual dairy farm businesses cannot influence the development and delivery of employment services involved in improving this situation; these require industry-based responses.<sup>10</sup>

One of the important aspects of any business strategy is planning by current owners of how to exit the business—either the management or the assets or both—when they wish to do so.

23% of the 152 responses from 71 farmers surveyed in the 2010 Dairy Industry Farm Monitor Project<sup>11</sup> nominated succession planning as their most pressing future decision. Participants who were concerned about succession in the business also mentioned concerns for their age, retirement options and work life balance. A recent study of milk supply in the Alpine valleys of NE Victoria<sup>12</sup> showed that in that region dairying was economically much more rewarding than grazing beef but there were significant barriers to continuation and expansion of dairy. These barriers were associated with farmers’ perception of their options for transition of management roles or assets. Further industry investment in understanding and promoting approaches to business succession planning are needed.

Everyone wants to be healthy and have a safe place to live and work. One challenge with dairy farms is that they are workplaces and also family homes. For the people

6 Preliminary results from further analysis of Dairy Australia's Situation & Outlook 2004-2009

7 Cost-benefit analysis, David Collins, Dairy Australia, June 2008

8 Labour survey, John Mulvany, GippsDairy 2000

9 Hamilton C, The Australia Institute 2009

10 Nettle R, Oliver D, Brightling P, Williamson J, Buchanan J (2008). From “Workforce Planning” to “Collective Action”: developments in the Australian dairy farm sector. *Employment Relations Record* 8(1):17–34.

11 Dairy Industry Farm Monitor Project, 2010

12 Mulvany J. Future dairy supply for Alpine Valleys NE Victoria. Report commissioned by Alpine Valleys Agribusiness Forum, 2010



Table 3. Nature of the desired changes around 'people'

On-farm	Local communities in dairy regions	Industry*
Farms have a people perspective in their business strategy	Communities have the resources and capacity (including networks, information, processes and leadership) required to be resilient and vibrant	There is a wide-held belief that people are the core to success
Farm businesses have the tools, process and access to high quality advice to build the people capacity and achieve change on their farm	Communities recognize and value the career and economic development opportunities that dairy offers**	Program managers include a people focus in the design of their initiatives
Farm consultants always consider details of people capacity in this planning	The dairy industry has good relationships with community financial services and keeps them abreast of dairy issues and outlook**	Core resources about managing people are available and their currency is maintained
Farm managers improve the way work is done on farm (have straightforward systems and the right people in the right job at the right time)	The dairy industry has good relationships with community employment, health and social service networks	Industry has the leadership it needs (with a strong farmer voice)
Farms offer decent work (work-life balance, safe, rewarding, skills development, career paths)	Farmers can easily access services they need around health, safety and well-being	The service sector wants to be part of change and has the capacity to advise on people issues
Great value is placed on effective working relationships	Dairy farm families are connected with their communities, and well-represented in community participation	There is effective workforce planning and action regionally and nationally**
Farms have a low business risk around their people resources		Industry has the resources it needs to promote dairy careers
Farms have efficient recruitment strategies		Industry is able to measure and track the value of people management in achieving business success

\*Developing the enabling environment for these changes is a prime area for collective investment

\*\* Involves joint action across industries to be efficient

working on the farm there are some very busy periods, long days, a wide range of weather conditions and the requirement to handle large animals and work with potentially hazardous equipment, environments and substances. Older and younger family members are quite often at greater risk of harm if exposed to these hazards.

There is recent evidence that the health status of dairy farmers is generally poor.<sup>13</sup> The Sustainable Farm Families program is a preventative health care initiative run by the National Centre for Farmer Health (in conjunction with DPI in Victoria). It offers a series of group workshops for farm family members to address the impacts of poor health and safety on farms. Baseline data collected in the first year of workshops demonstrated low health status of Victorian farmers who attended. Of the 964 farmers who attended, 70% were referred for additional health attention following the individual health assessments in the workshops, mostly for diabetes and cardiovascular disease.

Further collective investment around farmer awareness and action to improve physical and mental health, safety and well-being is needed to enhance the productivity and appeal of the industry.

RD&E/E needs to keep pace with the changes that dairy farmers face if the industry is to help them have the confidence, skills and information to make dynamic decisions—with people capacity at the core.

In 2006 Dairy Australia initiated a new program, The People in Dairy, to build the industry's capacity to match the people resource with the needs of farm businesses. At this time the goal in this area still had to be fully articulated, the specific needs identified and a clear path devised for what was required to make it work; it was definitely a program in the Development phase. Few service providers who worked in the dairy industry were confident to advise or signpost in the people area. There

had been multiple small (and innovative) projects on various aspects of the employment pathway but they were mostly short-term, localized, one-off exercises.<sup>14</sup> What was missing was a conceptual framework to enable farmers and service providers to differentiate between symptoms and root causes, and key principles to enable the industry to develop appropriate initiatives in response.

The types of change desired to achieve the vision of this strategy—that people are recognized and developed as the key drivers of sustained farm business success—are summarised in Table 3.

Achieving this type and scale of change will only be possible if the dairy industry takes a lead role. The whole-of-industry needs to change the way it thinks about people and communities, and develop a collective response that attends to the complex of issues around recruitment, retention and development of people in dairy. Mapping and alignment of initiatives will enable the industry to work at a 'systems' level. Coordination of efforts will provide momentum, synergies and potential opportunities for leveraging government investment.

As the Australian population and culture becomes increasingly urbanised, most dairy production operations remain located in rural and regional Australia. Dairy relies heavily on small rural communities to provide its workforce—it is estimated that 60% of dairy industry employees live in communities of fewer than 5,000 population. There are estimated to be around 270 of these communities in Victorian dairy regions.<sup>15</sup> Although it is known that farm businesses generate indirect employment in towns throughout country Australia through their expenditure on farm inputs and farm household goods and services<sup>16</sup> and that dairying has a strong "multiplier effect" in regional economies<sup>17</sup>, the extent to which dairying is valued by the communities in which it resides is largely unexplored.

Many of these small rural towns are facing significant challenges, including loss or degradation of infrastructure, access to water and other resources, loss of essential services such as health and education, competition for agricultural employees with other industries, urban encroachment, and youth out-migration. These challenges result in a dwindling population and economy, which can in turn precipitate further contraction of community services, infrastructure and capacity. The inevitable outcome for the dairy industry of this vicious cycle is a considerable workforce shortage in key dairy production areas, reduced well-being of dairy families, and potentially less innovation.

Wear (2008) reported that, all things being equal, greater community strength is associated with increased innovative activity. "Place" does matter and plays an

important role in supporting innovative activity through networks and relationships. Using provincial Victorian data, community strength was at least as important as many of the other factors driving innovation with informal networks, such as membership of organised groups (which includes everything from sport, church, community or professional groups) associated with innovative activity. This link to innovation extended to places where people felt safer, and more valued.<sup>18,19</sup>

However changes in dairy farming itself have also led to some fragmentation of community involvement. As farms are spread further apart, have different farming systems and calendars (with peaks of work load at different times from their neighbours) and increase in complexity it makes it more difficult for farm families to find the time, energy and passion to participate in the community as they once did.

The dairy industry needs to understand and acknowledge the importance of developing the strength, health and resilience of its communities and invest significantly in this area to ensure ongoing workforce security. We want local communities in dairy regions to be proud of and actively promoting their quality dairy produce and supporting the involvement of dairy people in community life.

In summary, the wealth creation and resilience of the dairy industry depends on the people who work in its farm businesses. The objective of the People Strategy is to help farms achieve their potential and make dairying an attractive career and investment by developing an industry culture that values people and building people capacity on farm. This requires long-term investment in a coordinated set of activities (R/D and E/E), and an ongoing process to refresh the priorities in the light of farmer requirements and changes in the external environment. Local communities in dairy regions that are vibrant and active and positive about the dairy industry will be appealing places for dairy people to live and work.

13 *Sustainable Farm Families Impact Evaluation 2007–09*, Roberts Evaluation report for DPIV, 2009

14 Nettle R, Johnson R. *A review of employment projects in the Australian dairy industry 1998–2006*, Final report prepared for the Dairy Employment Committee, January 2006

15 Paul Ford, Gardiner Foundation pers comm

16 ABARE 2000, *Australian Farm Surveys Report 2000*, Canberra

17 WestVic Dairy, 2010, *Driving Down the Track*. Warrnambool City Council regional economic activity report.

18 Wear, A. (2008) *Innovation and Community Strength in provincial Victoria*. *Australasian Journal of Regional Studies*, Vol. 14, No. 2, 2008 195

19 Pope, J. (2006) *Indicators of Community Strength: A Framework and Evidence*. State Government of Victoria: Melbourne

Pope, J. and Warr, D. (2005) *Strengthening Local Communities: An Overview of Research Examining the Benefits of Neighbourhood Houses*. State Government of Victoria: Melbourne

## 4. Existing RD&E/E (on-farm, cross-industry, community)

The Dairy Moving Forward process has identified the following list of current or recently completed projects that relate to the themes in this People Strategy. This list is not comprehensive but does demonstrate a broad range of activities which is estimated to be approximately \$2–3M per annum in collective investment.

Table 4. Existing RD&E/E

Theme	Project or activity name	Organisation responsible	Completed or ongoing	R,D,E	Comments
1&2	The People in Dairy online resources	DA (The People in Dairy)	2008-ongoing	D,E	
1&2	MGFarm	Murray Goulburn	2009- ongoing	D,E	The People in Dairy 'People Basics' integrated into the Murray Goulburn website
1&2	PrimeFacts	I&I NSW		E	Fact Sheets posted on I&I NSW website
1&2	The People in Dairy awareness sessions	I&I NSW, DairyTas	2009-ongoing	E	
1	Large Herds Extension Program	DairyTas	2010-12	E	Group work for large farms including retreats
1	The People in Dairy Large Herds Business Retreat	DA (TPiD)	2009-ongoing	E	2-day workshop for owners and managers of large herds (800+ cows) to assess their business strategies from a people perspective.
1	Rural Financial Counselling	DAFF (RFC)	Ongoing	E	Rural Financial Counsellors have skills and knowledge in developing farm business strategies and have recently increased their focus on assisting farmers with succession planning.
1	Dairy Smart	TIAR	2009-ongoing	E	Regional groups meeting 6-7 times per annum on wide range of management issues including people
1	In-Charge Financial Literacy Workshops	WestVic Dairy	2010-ongoing	E	For farmers who want to improve their financial management skills, improve their business profits and build wealth and help the farm team build better plans
1	Business management workshops	I&I NSW	Completed (2010)	E	Reinforcing the principles around profitable and sustainable dairying, particularly emphasising skills assessment and training

Theme	Project or activity name	Organisation responsible	Completed or ongoing	R,D,E	Comments
1	Taking Stock: Taking Action	DA/DAFF DairyTas	2005-2010	E	First launched as part of the crisis response to the prolonged dry in 2005, later supported by DAFF to help farms in the Murray Darling basin and DairyTas in Tasmania. A one-on-one consultation with an experienced adviser to assess how the business is going and use this as the basis for discussions about planning. It explores the physical, financial and people issues on the farm.
1	First Farm Grant	Rural Finance Corporation	2010 – 2011	E	\$3000 grant for young farmers to undertake business planning with the assistance of a consultant. A further \$7000 is available to develop projects on farm.
1&5	Young Agribusiness Professionals	VFF	Ongoing	E	Activities for younger members of the VFF. Recently received state government funds to offer more activities and events.
1	Client stocktake survey	RIRG	Completed 2009	R	
1	3030 project: Social research	RIRG	Completed (2006-10)	R	
1	Dairy Live evaluation (I & II)	RIRG	Completed (2009-10)	E	
1	Enhancing the resilience of dairy farm businesses	RIRG	Completed (2005)	R	
1	Changing rooms in the dairy industry: Leaving a legacy from crises	RIRG	Completed (2009-10)	R	
1	Farms, Rivers, Markets	RIRG	2010-ongoing	R	
1	Managing Your Own Business Continuity	DairyTas, AusIndustry	Completed (2006-2008)	E	Awareness workshops and 1-on-1 planning sessions with a consultant, focused on succession planning
1&3	Future Dairy in the Alpine Valleys	Alpine Valleys Agribusiness Forum (with Murray Goulburn and RDV)	2010	R	Exploration of the drivers (business strategies and people issues) behind dairy supply in Vic NE

Theme	Project or activity name	Organisation responsible	Completed or ongoing	R,D,E	Comments
1,3&5	Young Dairyfarmer Networks	RDPs, TIAR, DA, sponsors, (previously also GGDF, UDV)	Ongoing	E	The Young Dairyfarmer Networks (including Young Dairy Development Program in Victoria, and Next Gen in Tasmania) aim to meet the needs of young dairy farmers and those who are new to the industry with personal and professional development. Professional via attending the events either delivered by the program or signposted; personal by having a network and improving confidence via the committee processes and events.
1	Murray Dairy Business Networks	Murray Dairy & GGDF	Completed 2010	E	Enhancing the business skills of farmers to manage uncertainty by promoting sound principles in business management and highlighting dairy farming as a profitable and rewarding career.
2	Innovation in employment 'Employment guidelines for employers and employees – from employers and employees	GippsDairy, Industrial Relations Victoria	Completed (2004)	R, E	The aim of the project was to learn about what constitutes good effective working relationships between employers and employees. Over a period of 12 months 18 farm businesses and their employees meet on a regular basis and through facilitation developed a booklet on practical employment guidelines.
2	Diploma Human Resource Management (Dairy)	NCDEA (DA/ TPiD)	2008-ongoing	E	Formal development of existing farm consultants and advisers skills as human resources practitioners. Provides a framework to think through issues around people capacity and workplace culture on farms. 64 people have now been through the course.
2	PeopleGPS	NCDEA + partner RTOs (DA/TPiD)	2009-ongoing	E	4-day course for small groups (of 10-15) farmers which helps them develop skills in recruiting, retaining and developing the people on their farm. The course is a Level V unit and FarmReady approved. All trainers have completed Diploma HRM (Dairy). Approximately 200 people have completed in Vic, NSW, Qld and Tas (including pilots).
	The People in Dairy workforce development	RIRG	2007-ongoing	R	



Theme	Project or activity name	Organisation responsible	Completed or ongoing	R,D,E	Comments
2	Valuing People in Sustained Dairy Business Success	RIRG; DA (TPiD)	2009-ongoing	R	
2	Focus Farms	DA (GippsDairy, WestVic Dairy, and Murray Dairy)	Ongoing	E	GippsDairy Focus Farms have a support group meeting monthly on farm with a facilitator for two years to help the focus farm family achieve their goals, as well as cover timely technical information. Goals include business and family issues (eg increase return on asset, "get business ready for a manager so I can step back").
2	Devondaler Newspaper	Murray Goulburn	Ongoing	E	Current case studies of farming families focus on farming systems, business systems, people systems, succession planning etc.
2,3	Dairy Knowledge Framework	NCDEA	Ongoing	D	Establishing and maintaining an industry agreed list of knowledge and skills required at different levels of the responsibility on farm
2,3	Growing the New Generation	Victorian RDPs	Completed (2005)	E	Dairy Business Networks supporting farmers around employment practices
3	Workforce Planning and Action	RIRG, GGDF, GippsDairy	Completed (2007-09)	R	Development of a regional process for the dairy industry and the community it is within to better understand and action a system of workforce development, including assessment of demand, supply and possible interventions. Initial work in this process was completed within the Baw Baw Shire, Gippsland.
3	The People Report	DA (TPiD, RIRG NCDEA)	2010-ongoing	R,D	Review of data around people with periodic update (Situation & outlook – People)
3	Murray Dairy workforce survey	RIRG	2010-ongoing	R	

Theme	Project or activity name	Organisation responsible	Completed or ongoing	R,D,E	Comments
3	In2Dairy – Entry-level pathway for Assistant Farmhands	DA (WestVic Dairy)	2010-ongoing	R,D,E	<p>Pilot program in Western Victoria. A joint action initiative between many different organisations/businesses:</p> <p>Engagement of the Job Services Australia network to identify job seekers who may be interested in a career in the industry starting as Assistant Farmhands</p> <p>Participation by the job seekers in a 10 day program of accredited pre-employment training (some units in Cert II) offered by the NCDEA</p> <p>Decision by some of the job seekers to progress to traineeships (with NCDEA) on dairy farms</p> <p>Identification by WestVic Dairy of dairy farms that need entry-level staff and are interested to participate in the program (take on a trainee)</p> <p>On-going support by WestVic Staffing Solutions for both the trainee and farmer to assist the employment relationship</p>
3	Cows Create Careers	DA (Jaydee Events), I&I NSW/ GGDF	2004-Ongoing	E	<p>Promotes career and educational opportunities in the dairy industry to secondary school students, with the assistance of local dairy farmers and local dairy industry professionals, such as vets, dairy company field officers, agronomists and cheesemakers. All regions are running Cows Create Careers. Approximately 170 schools and 6000 students are expected to participate in 2010–11.</p> <p>New “schools to industry” work experience module being developed 2010–2011</p>
3	Picasso Cows	DA (Jaydee Events), I&I NSW	Ongoing	E	<p>The Picasso Cows initiative aims to engage primary school students and increase awareness of the Australian dairy industry and its products. This is done through the creativity and teamwork involved in painting a life size fibreglass cow and creating a class learning journal.</p>
3	Rotary Youth in Agriculture (Dairy)	Rotary, I&I NSW	Ongoing (annual)	E	Youth camp

Theme	Project or activity name	Organisation responsible	Completed or ongoing	R,D,E	Comments
3&5	DairySAGE Mentoring	GGDF, WestVic Dairy DA	Ongoing	D,E	Capacity building initiative to provide the Australian dairy industry with a sustainable framework to establish mentoring relationships; by partnering experienced, mentors with dairying people from all sectors of the industry; including the farm, manufacture and service sectors.
3	Dairy Traineeship Scholarship	I&I NSW; Norco	Ongoing	E	A focus on new generation farmer development to enhance capacity, knowledge, skills base and decision-making for long term sustainable growth and development
3	Retaining people in dairy farming - what is working and why?	RIRG/ GGDF	2010-ongoing	R	
4	Managing stress in tough times: a practical guide for farmers and service providers	Western Dairy, Govt WA	2010	E	Drought response resources
4	Sustainable Farm Families	Western District Health Service; delivered in partnership with DPIV and GGDF	2005-ongoing	R&E	Farmer workshops which focus on the importance of farmer health and wellbeing not just for individuals but also for the health of the farm business. New research being undertaken 2010-2011 to evaluate lasting impact of initial 2006 program, and identify future directions.
4	Volunteerism in small Communities	Originally sponsored by GGDF		E	Running in SW Victoria
4	National Centre for Farmer Health	Western District Health Service; Deakin University	2009-ongoing	R&E	Online resources and range of delivery activities
4		Foundation for Rural & Regional Renewal	Ongoing		Established as a partnership between philanthropy, governments and business to stimulate rural and regional renewal in Australia
4	Strengthening Small Dairy Communities	GGDF	2010-ongoing	RD&E	Partnering with shires and industry to develop and implement community-driven strengthening programs, focused on skill development and building on-going capability in identifying issues & priorities, securing funding, and managing community projects.

Theme	Project or activity name	Organisation responsible	Completed or ongoing	R,D,E	Comments
4	Small dairy community grants	GGDF & FRRR	ongoing	D	Annual funding round of appx 20 x \$5,000 grants for community improvements in small dairying towns
4	Gateways 4 Sustainable communities	Northern District Community Health Service & GGDF (with other shire & govt funding)	2008-2011	D	An innovative partnership project to improve opportunities for young people, enhance community links and build upon regional capacity.
5	Dairy industry blueprint for leadership development	ADIC / DA / GGDF	2010-ongoing	D,E	There is an enormous requirement for the industry to identify and skill the next generation of leaders who can act at political, company, service, research and farm business levels. A number of stakeholders invest in this area and this industry-wide plan is designed to increase the efficiency and effectiveness of this investment.
5	Growing the Next Wave	Regional Development Victoria, delivered by WestVic Dairy	2010-ongoing	E	Develop young community leaders in south-west Victoria and help them strengthen their community links
5	Young Dairy Networks	Multiple sponsors	Ongoing	E	Young dairy activities in all dairying regions (Young Dairyfarmer Development Program YDDP in Victoria).
5	Don Campbell tour to Tasmania	GippsDairy	Ongoing	E	Annual 5 day tour to the northern dairy belt of Tasmanian for young farmers.
5	Nuffield Australia Farming Scholarships	GGDF and DA sponsorship of dairy participants	Ongoing	R&E	
5	Australian Rural Leadership Program	ARLP Foundation (multiple sponsors)	Ongoing	E	
5	Bonlac Supply Company Leadership Program	Fonterra / Bonlac Supply Company	Ongoing	E	Continuation of the BSC leadership program. Nine Fonterra suppliers across Vic and Tas completing the program
5	Fonterra Supplier Forum	Fonterra	Ongoing	E	Supplier forum consists of 18 Fonterra suppliers covering Vic, Tas, NSW and WA.
5	MG Supplier Development Program	Murray Goulburn	Ongoing	E	Program to provide MG Suppliers with the opportunity to understand more about the industry, their cooperative, and their own leadership ambitions.

Theme	Project or activity name	Organisation responsible	Completed or ongoing	R,D,E	Comments
5	Next Generation Leadership Development Program	Dairy Australia /NCDEA	2011	E	
5	Dairy Famers Milk Co-operative Supplier Development Program	Dairy Farmers Milk Co-operative	August 2010 – December 2010	E	Supplier development program for 5 young suppliers (18-35 years).
5	Company Directors course	UDV/GGDF	2010-2011	E	Enhancing the capability of UDV Central Council by sponsoring 2 places on the Aust Institute of Company Directors course.
5	Dairy participants in Community Leadership Programs	GGDF (with 4-5 Vic CLPs)	Ongoing	E	Developing leadership capability within the Victorian dairy industry.
5	Apprentices study tour of NZ dairying	UDV/GGDF	Ongoing	E	A major professional and personal development experience for Victoria's top dairy apprentices - grooming young ambassadors for the industry.
5	Marcus Oldham Rural Leadership Program	UDV/GGDF	Appx 2002-2007??	E	



## 5. Theme 1: Farm business strategies have a strong people focus

### The need

#### To achieve sustained business success:

- › Dairy farms need appropriate and well-implemented farm business strategies, where the strategy and ability to resource it have been considered from a people perspective (goals, roles and skills etc).
- › Farm business strategies must include consideration of transition of farm assets when owners wish this.
- › Farm owners and managers must have the motivation, skills and confidence to manage the people in their farm businesses.
- › Farm consultants and advisors must be able to support quality decision-making around development of the farm business strategy.
- › The value proposition for taking action in this area must be apparent.

### Who for?

#### Farm owners and managers (including those up-and-coming to this role).

Others who need to be involved in the development: organizations and individuals with interests in farm business management and people capacity (including farm consultants; financial institutions – accountants and banks; training and extension organisations)

### Rationale

#### Farms are a multitude of competing priorities.

It is difficult to achieve sustained business success unless there is a vision for the farm business and it matches the capability and resources of the farm. This is the bailiwick of farm owners and managers; they guide the direction of the farm business, make decisions and are responsible for implementing them. As such they are key instruments of industry adaptation and well-being.

Most Australian dairy farms (98%) are still family-owned businesses and owner-operators report long work hours (average 3400 hours per year, or 68 hours/week for 50 weeks).<sup>20</sup>

Being chronically overloaded and overwhelmed with the number of jobs that need doing on farm are symptoms of a problem: trying to do the impossible because of a system that is not well designed for the available resources (people, infrastructure etc).

Productive, smoothly running farms make staying in the industry and growing the business attractive options.

Having inspiration and a strategic guide is as important for the 7,400 farm businesses as any other business enterprise. This is commonly achieved by articulating a business vision: a statement of where the business wants to be in the future. Businesses can then use the vision when faced with decisions to check their fit.

Then the roles necessary to implement the strategy must be specified. This is not always as straightforward as looking to employ another milker. There is increasing demand for higher levels of farm management skill as herd sizes expand, and need for “second-in-charge” managers and experienced production supervisors. This leads to an increasing need for training, and elevated importance of the relationship between owners and senior managers. When there is more than one person looking after the system there has to be communication, understanding and trust between the people in charge of the different elements of the farm.

And finally the farm must have systems that are simple to put into practice. A way of operating that is documented and well-understood by all team members (standard operating procedures) removes the risks of a relying on a single passionate person.

Farm businesses are likely to have enormous challenges into the future. This cannot be managed in isolation: the quality of decision-making relies on having a network and good relationship with the advisory environment.

### Current knowledge and capacity

#### It is necessary to establish the value proposition for “getting people right” to convince funding bodies, stakeholders and farmers to invest in this area.

But it is difficult to quantify the effects that better people management has on sustained farm profit as many of the qualities that make a difference (such as workplace culture and working relationships) aren’t easily measured. A research project on ‘Valuing people in sustained dairy business success’ was started in 2010 to give a better understanding of the link between labour and profitability.

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<sup>20</sup> Dairy Situation and Outlook, 2008, Dairy Australia

Table 4 *Existing RD&E/E* in this document describes existing capabilities and supply in this area. In summary:

- Many dairy networks run formal and informal farm business management sessions for their local farmers.
- The NCDEA offers many units (from the National Training Package and Industry Endorsed Qualifications) for those interested in senior management positions on farm such as Business Manager Advanced Diploma of Agriculture, Production Manager Diploma of Agriculture and Farm Supervisor Certificate IV in Agriculture.
- Since the pilot in 2010, owners and senior managers of large herds can enroll in a Large Herds Business Retreat with The People in Dairy. The aim of the facilitated small group discussion over 36 hours is to ensure people issues are not constraining the businesses from achieving their financial and production goals.
- Some farm consultants continue to offer 'Taking Stock: Taking Action' (or equivalent) consultations to clients on request. These consultations assess the physical financial and people aspects of a farm business and use this as the basis for discussions about planning for the next season and beyond.

## Investment priority areas

### A. Demonstrate the value of getting the people management right on farm

- Develop a full understanding of the value of getting the people component right ('Valuing People in Sustained Dairy Business Success')
- Raise farmer awareness of the value of 'getting people right' (farmer case studies)

### B. Support the capacity of farm owners and managers to develop their business strategies around people (including succession planning)

- Provide ongoing access to clear, consistent, relevant information and resources (e.g. The People in Dairy online resources)
- Increase the capacity of farm consultants to support farmers on people issues
- Increase the confidence of farm owners and managers (including the next generation of decision makers) in managing the people capacity on their farms (eg 1-on-1 consultations, NCDEA training, Large Herds Business Retreat)
- Develop resources and case studies demonstrating different approaches to transition farm assets
- Increase the capacity of farm owners to establish and communicate plans for farm ownership transition

### C. Support farm owners and managers in their ability to competently and confidently manage complexity and uncertainty in all decision making (assist priority area with other portfolios)

- Increase the confidence and capacity of decision-makers to manage change (training, 1-on-1 consultations). This in particular requires joint effort with the Farm Business Management element of Dairy Moving Forward.



Table 5. Capabilities - Theme 1 Farm business strategies have a strong people focus

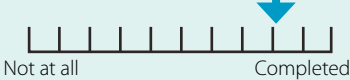
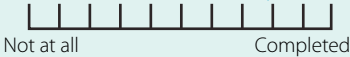


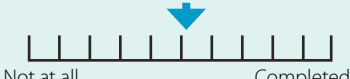
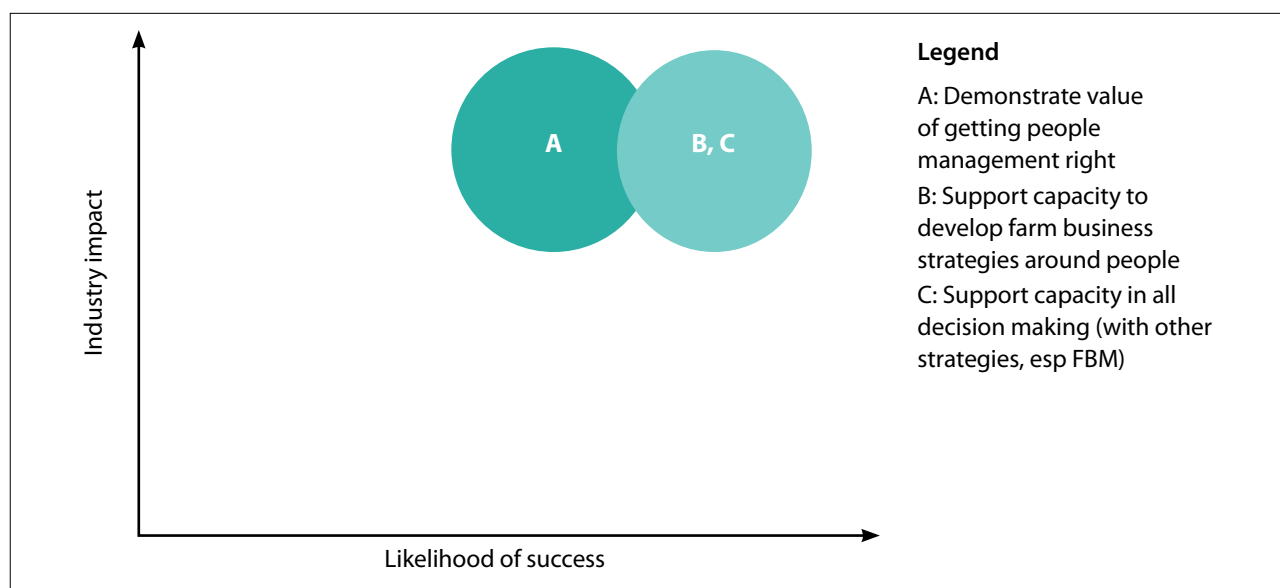
Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		Relevant organisations exist, improvements in collaboration possible. Succession planning requires a broader base
Do these people and organisations represent the majority of prior learning in this area?		
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		
Would the collaborators be able to provide diverse avenues for change?		Current avenues well developed but new avenues could be explored to maximise benefits from investments
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		

Figure 3. Industry impact: Theme 1. Farm business strategies have a strong people focus



\* Dependent of course on resource allocation

## 6. Theme 2: Farm workplace change

### The need

#### To help individual farms have a more efficient and productive workforce, the industry needs to:

- › Design initiatives that help individual farms attract and retain the people they need.
- › Build the capability, confidence and enthusiasm of advisers to support farmers on people issues.
- › Encourage farms to have a low business risk around 'people'.
- › Have people as the focus when designing ways of operationalising technology in other programs.

### Who for?

#### Everyone in the farm team (farm managers; paid, unpaid and casual staff, contractors and service providers)

Others that need to be involved in the development: The People in Dairy program, NCDEA, extension programs, other dairy programs.

### Rationale

#### Several key elements are needed to increase farm profitability through a more efficient and productive workforce:

(i) the business vision needs to match the farm capability and resources; (ii) farms need to attract and retain the people they require; (iii) the way farming is done needs to be adapted to suit people; and (iv) everything that must be done on the farm needs to get done.

Farm owners and managers are responsible for setting up a system that is workable and sustainable (Theme 1). Theme 2 is about helping farmers achieve effective deployment and retention of staff on their farms by providing opportunities, structures and support to grow the people capacity. A solid reason for putting it into action is that people leave workplaces that don't offer decent work (farms that have poor workplace culture, work-life balance, recognition or reward).

Much of the rationale for dairy workplace change was articulated in 2004:<sup>21</sup>

*In the past, the small family farm was the incubator of farming skills. Today, family farms no longer fill this role. Farmers must look outside their front gates and compete with other industries for labour. When they do they find it hard to recruit and retain labour. There are some good external reasons for this. Young people are leaving the farming areas. The dairy industry has a poor and outdated image. But most of the causes of the problem are systemic and internal to the industry. There are relatively uncompetitive pay rates, unattractive working conditions, poor employment practices and high turnover rates on many farms. The industry is seen as an employer of last resort by many job seekers as well as by employment and training agencies. There is a high rate of exit – not just of farmers but also of sharefarmers, trainees and employees. The very high turnover rate means that the industry is bad at retaining and skilling staff. Turning around this current situation will require significant leadership, organisation and resources. Failure to act will bring the consequences of market adjustments – at home in the labour market and abroad in export markets.*

Job satisfaction and retention are significantly influenced by the mindset of the employer, getting the culture right on farms and skills development (having visible career opportunities and appropriate training pathways).

*Better trained and skilled people increase productivity and profitability: get it right first time; reduce personal and business risk (injury and liability); make smarter decisions; build intellectual capital (knowledge, skills, systems); build your business for you*

– John Weichert, General Manager NCDEA

When other technical programs design their RD&E/E to provide farmers with new ways of doing farming tasks, it is particularly important that they consider the implications from a people perspective. On-farm use of technology (knowledge, service or product) is most likely to be successful if its design is adapted to suit people.

### Current knowledge and capacity

Since its start in 2006, The People in Dairy has developed a conceptual framework, agreed terminology, core resources and training around people management on farm. Dairy farmers now have access to a lot of guidance on how to put the principles into action and significant 'dairy-ising' of generic information has been undertaken to reduce the burden (in terms of time and interpretation) on farmers and help them put it into practice.

A Diploma in Human Resources Management (Dairy), run since 2008, is helping build advisory capacity in this area and provide the first round of trainers for the related course for farmers. Sixty-four farm consultants and dairy

<sup>21</sup> *Dairy Employment for the Future: the strategy*, Australian Centre for Industrial Relations Research & Training, University of Sydney (an initiative of the UDV sponsored by WestVic Dairy and funded by the Geoffrey Gardiner Foundation), July 2004

advisers have been through the course so far. Ideally the numbers over the next few years would be twice this to provide widespread geographical coverage, cater for turnover in the service provider population and unearth those individuals willing to make this a significant part of their business.

The other main supply capacity in this area is the 4-day PeopleGPS course for farmers. This is a Level V unit (FarmReady approved) course run through the NCDEA or partner Registered Training Organisation. It helps farmers develop skills in recruiting, retaining and developing the people on their farm.

## Investment priority areas

### A. Ensure farmers have clear, consistent information and resources about people management

- Maintain the currency of The People in Dairy online resources

### B. Increase farmer awareness and training about people management

- Have a strategy promoting recruitment of farmers into the People GPS
- Enable individuals to understand the importance of skill development, and see career opportunities and how they can progress

### C. Increase adviser capacity to support farmers on people issues

- Continue training advisers in the Diploma in Human Resources Management (Dairy)
- Encourage diploma graduates to use the principles in their businesses
- Make other dairy advisers aware of people issues and confident to direct clients to trained advisers and resources
- Align initiatives of the (public and private) service sector to support farmers on people issues (service and extension providers, NCDEA, The People in Dairy etc)

### D. Assist other programs to integrate people elements into their technical content

- Enhance the outcomes of other dairy programs by incorporating people considerations in their design and adapting farm systems to suit people.

Table 6. Capabilities - Theme 2 Farm workplace change



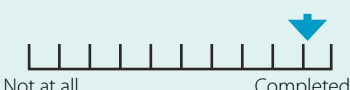

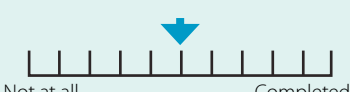
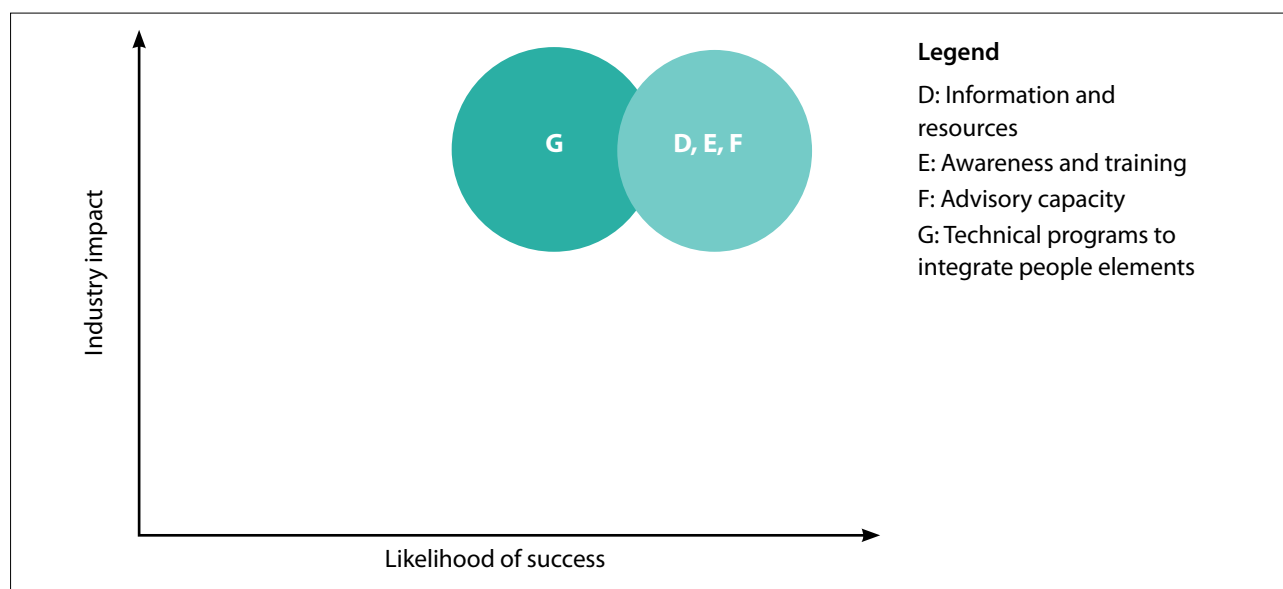
Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		Relevant organisations exist, improvements in collaboration possible
Do these people and organisations represent the majority of prior learning in this area?		
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		
Would the collaborators be able to provide diverse avenues for change?		Current avenues well developed but new avenues could be explored to maximise benefits from investments
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		



Figure 4. Industry impact: Theme 2 Farm workplace change



\* Dependent of course on resource allocation

## 7. Theme 3: Dairy workforce development planning and action

### The need

**To ensure the Australian dairy industry has the people it needs, it must have effective workforce planning and action processes operating regionally and nationally. This involves:**

- A culture change in terms of how farmers and industry value people in their contribution to farm and business performance<sup>22,23</sup>
- Building the community regard and support for people interested in careers in dairy.
- Being able to measure factors that influence workforce planning and action from a strategic point of view.
- Exploring ways to match demand and supply.
- Being able to operationalise regional workforce planning.
- Promoting and supporting development of people capacity within the industry.

### Who for?

#### Farmers

Others who need to be involved in the development: state and regional dairy organizations to champion the dairy interest, working with other public, private and not-for-profit service providers and industries outside dairy as indicated by the Workforce Planning and Action model ('wheel') recently developed.<sup>24</sup>

### Rationale

**Although individual workplaces must position themselves well to attract and retain people, there are also collective workforce development activities that enhance the likelihood of farms attracting, retaining and developing people. This is a key to the dairy industry's future.**

Farms are part of a broader community and their appeal as workplaces will be influenced by regional (national and occasionally global) factors. Currently unemployment levels are low and skilled people have many career choices. Individual dairy farm businesses cannot influence public policies on employment or the development and delivery of employment services involved in improving this situation; it requires an industry-based response.

Workforce planning has a much broader scope than a strong skill base and skill development. People may have the relevant skills then choose to work in a non-dairying job that appears to be more interesting or offers a better work-life balance or a higher reward.

22 Nettle R, Paine M, Petheram J (2005). *The Employment Relationship – a conceptual model developed from farming case studies*. NZ J Employment Relations 30(2):19–36.

23 Nettle R, Paine M, Petheram J (2006). *Improving employment relationships – Findings from learning interventions in farm employment*. NZ J Employment Relations 31(1): 21–36.

24 Nettle R, Oliver D Workforce Planning and Action for the Australian Dairy Industry. Final Report to Gardiner Foundation 2009

For more effective industry-wide workforce planning and action we need:

- Comprehensive and on-going data harvesting, analysis and interpretation on the people deployed on farm and how they enter, develop and move through the farm sector; tracking of training graduates (e.g. from NCDEA); the size and characteristics of current and future labour demand
- Better support to dairy regions for prioritising and acting on workforce development
- Mechanisms for influencing government and other stakeholders to address needs.

This theme also encompasses the workforce development elements for service providers who are part of the overall farm team around people issues. It would make sense for this work to be done in conjunction with, or as part of, a broader investigation of the total service provider population (which is outside the scope of this Strategy alone). It is very important for the industry to know more about who all the service providers are, their attitudes and expectations in working with dairy farms, how they enter, develop and move in the service provision sector and the characteristics of current and future demand for their services.

### Current knowledge and capacity

Regional workforce planning is still largely in an R&D phase. The theory of what process regional groups can use to better understand their workforce supply, demand and potential interventions has been teased out in an earlier research exercise and is captured as the Workforce Planning and Action 'wheel'.

The task now is to work through how to put it into practice—having workforce plans and actions pertinent for each dairying region.

There are several challenges ahead. The development of workforce plans needs to be resourced. Dairy industries in each region need to work with other industries and agencies to get a true picture of the driving forces in the region (local industries, business numbers, demographic profile, social and economic indicators) then to align the capability sector (education, extension, service provision, industry programs). Successful projects may require a mix of input from all levels of government (Federal, State and Local), and other interested parties such as banks and dairy companies. Someone in the dairy industry needs to take a lead role to champion the industry's interests and ensure progress continues to be made on the agreed plan. Finally, putting the plans into action and reaching a quality endpoint relies on a process of "learning by doing" (there is often a lot of doing and slow accretion of learning).

WestVic Dairy has responded to regional workforce issues by directly employing a project officer to promote careers in dairy and oversee the pilot of a pathway for new people to enter the industry as assistant farmhands (an "In2Dairy" initiative). This creation of an employment pathway for current job-seekers has immediate returns and complements the longer-term investment in raising the profile of dairying as a career through schools-based programs (such as Cows Create Careers). Murray Dairy has also recently invested in exploring the need for employees in the region through a farm survey. Other regions interested in 'having a go' in developing and implementing will need significant support.

Training is an important component of national workforce planning. There are currently two main drivers for training in the industry. Now that expertise is often outsourced beyond the farm, the first arises from the emphasis being placed on qualifications for employees, contractors and casual staff to ensure they are suitably skilled when they come onto farms. The second is because the dairy industry is systemically building the professional qualifications of the people working in it to prove it is operating at a standard alongside other OECD countries. For farm owners and managers who have been in the job for years this certification generally involves a mix of training and Recognised Prior Learning. Advantages of formalizing industry members' learning through the National Training Qualification Framework are that people are assessed against a specified standard, they have a transportable qualification and it attracts external (government) funding to the industry.

To help align the industry capability sector NCDEA is producing a single industry-agreed list of skills and competencies, an "Industry capability list", of all the things that people need to know to run a productive and profitable dairy farm. To further support strategic investment in this area, industry will need to develop a "big-picture" map clearly detailing all of the industry's career engagement and development programs and courses (not just NTQF courses), how they connect to each other and gaps for further investment.

This People Strategy does not take carriage of the training agenda—that is a broader element for all the Dairy Moving Forward portfolios, mediated through the NCDEA—but it is anticipated that work in this domain will assist with this priority.

## Investment priority areas

### H. Describe and promote the dairy career engagement / development path.

- Develop a map of career engagement/development programs and activities

### I. Establish and maintain an industry-agreed list of skills required at different roles and levels of the responsibility on farm (assist priority area with other portfolios)

### J. Obtain relevant regional and national data about people on farm and service providers

- Develop a system that tracks the basic data about people (The People Report)

### K. Enhance regional capacity to match employment demand and supply (for farm and service providers)

- Support the development of workforce planning process in each region (In2Dairy initiatives)
- Understand the forces influencing farm transitions – entries, development, exits

Table 7. Capabilities: Theme 3. Dairy workforce development planning and action


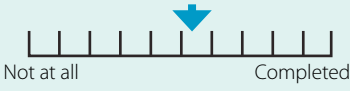
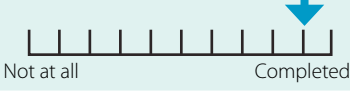


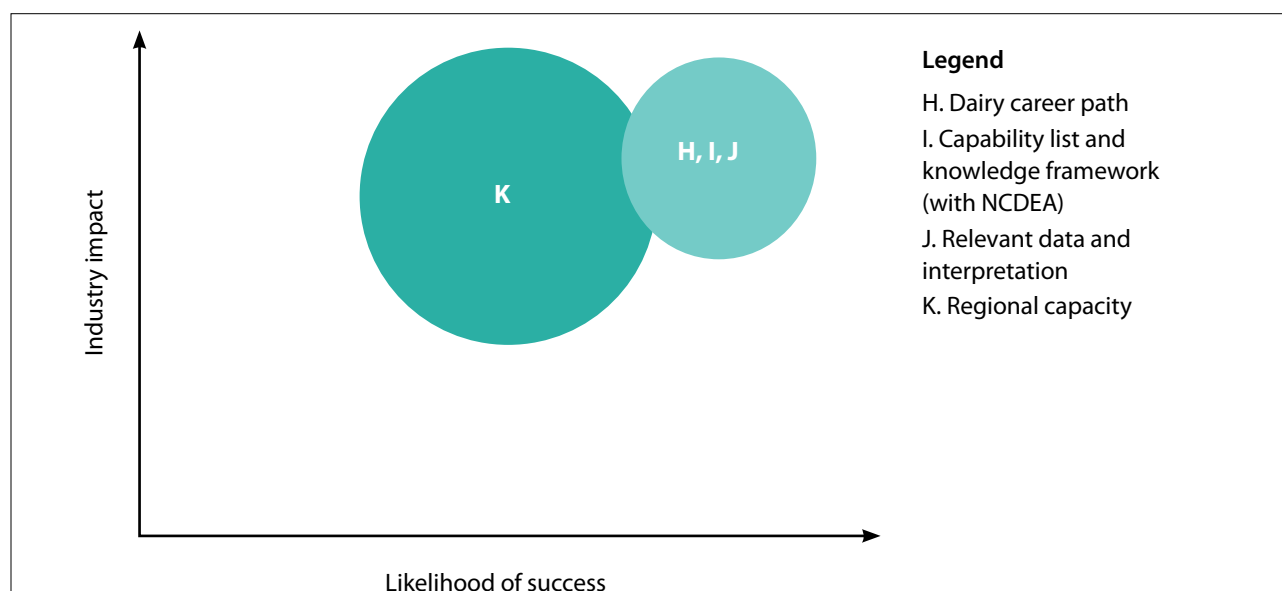
Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		Collaboration with non-dairy organisations will be important in this area but relationships must be developed
Do these people and organisations represent the majority of prior learning in this area?		
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		
Would the collaborators be able to provide diverse avenues for change?		New avenues must be explored to maximise benefits from investments
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		Capability must be developed at national and regional levels

Figure 5. Industry impact: Theme 3. Dairy workforce development planning and action



## 8. Theme 4: Farmer well-being in supportive communities

### The need

**For the dairy industry and its people to be supported by local communities that are vibrant and self-determining, the dairy industry needs to:**

- Acknowledge the vital role small rural communities play in supporting the dairy industry, especially the health and well-being of farmers and their families
- Better understand the factors which affect the vibrancy and resilience of these communities, and the key indicators of their vibrancy and resilience
- Develop strong links with the services, assets and networks within the communities
- Enhance connectedness of farmers to relevant services and networks
- Identify and nurture ways of engendering farmer satisfaction with being part of a dairying community
- Clearly demonstrate the contribution and opportunities dairy offers to these communities.

### Who for

#### Local communities in dairying areas

Others that need to be involved in the development: social researchers (DPI, Gardiner, Rural Innovation Research Group, psychologists), providers of social (rural counsellors) and other services (dairy processing companies, farm consultants), rural networks, local and state governments, and community groups.

### Rationale

**Vibrant communities have robust capacity to identify their own needs and priorities, plan and adapt to changing circumstances.**

They are collaborative, self-determining and able to work with a range of external agencies and support services. Their towns attract investment and are desirable places to live and work. The premise is that when these communities see the value of the dairy industry and support its development, there are likely to be fewer premature exits from the industry and dairy businesses are more likely to thrive.

The vibrancy of the community is affected by factors such as the size of the community, its focus (diversity), leadership, economics and a range of external factors. Indicators of stronger communities include the extent of close personal networks, extent of associational and community networks and quality of governance networks.<sup>25</sup> Research into the dairy industry drought

response suggesting that such characteristics contributed to the resilience<sup>26</sup> of the dairy industry in the Goulburn Valley through a strong support network for farmers. It was, however, necessary to support those networks themselves to move from a focus of handling crisis to understanding and adapting to an environment that is undergoing long term change.<sup>27</sup>

A key principle in Theme 4 is the importance of a network-based approach where multi-directional information flows (often very informal in nature) enhance connectedness and responsiveness. This requires a broad raft of activities and a wide cast - the people most effective at connecting with others are not necessarily community leaders or technical experts. Increased connectedness increases the likelihood that people will feel a sense of worth and belonging. Social network research has identified key people as “knowledge entrepreneurs” who draw from and share information and know-how in local communities.<sup>28</sup>

Encouraging farm businesses to comply with legal requirements is one of the first steps on the OH&S trajectory toward creating a better farm situation, health and well-being. Putting farmers’ physical and mental health and well-being in the context of their lives rather than just in the context of their businesses and connecting them to relevant services, are fundamental in raising awareness of the importance of health, well-being and safety for people on dairy farms.

RD&E/E activities designed to influence this outcome area are generally long-term investments with lag times, so longer commitments are required. Dairy communities are broader than just their dairying members and so not all outcomes/objectives will be entirely ‘dairy-centric’. Community development principles and practices must

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25 Dept Planning and Community Development (2008) *Indicators of Community Strength: a framework and evidence*

26 *The ability to actively manage resilience is referred to as adaptive capacity (Resilience Alliance, 2007: 77). Conceptual models of systems enable practitioners to identify the thresholds within which the system is operating; explore the processes that may cause the system to cross these thresholds; and develop actions that may give leverage over thresholds. Practitioners can also consider the cross scale linkages of the system they are working with and how these may give leverage over resilience. These skills are vital in managing crisis.*

27 Love, S., Sharma, M., Boxelaar, L. and Paine, M. (2008) *Enhancing the resilience of dairy farm businesses. Final report, Dairy Australia.*

28 BJ King, MS Paine, R Beilin, and MP O’Kane (2009). *Encounters with knowledge entrepreneurs and ‘sticky’ knowledge transfer: Case Study Project 3030. Extension Farming Systems Journal 5:1* <http://www.csu.edu.au/faculty/science/saws/afbmnetwork/efsjournal/index.htm> 11

## Investment priority areas

**L. Increase farmer awareness of the importance of health, wellbeing and safety for them, their families and their businesses**

**M. Build community ability to provide links to existing health, wellbeing, safety and support services and programs**

**N. Support and strengthen the capacity of farm communities to determine their own futures (including building relationships with non-dairying community segments)**

- Build facilitation skills, processes and new technology to keep people connected
- Foster strategic analysis and planning by communities, grant-seeking, leadership and project management skills to build capacity to be self-determining
- Use social research to help identify barriers and design better programs and practical evaluation of current activities

underpin planning and implementation. The “whats” (issues, causes, opportunities, priorities) will vary between communities with regard to capability building and strengthening. Industry needs to support the “how”.

Outside the industry, there is a rich variety of organizations, resources and programs aimed at developing and strengthening communities of all kinds. The dairy industry needs to tap in to these resources and networks, and partner or collaborate to use the relevant elements, and invest in adapting for dairy farmers what is not relevant or available.

The Expert Group acknowledges that there is still a challenge to demonstrate to industry organisations and dairy farmers the need for and value of investment in community strengthening.

## Current knowledge and capacity

There are a lot of services already reinforcing the importance of health and well-being and helping people

operationalise this. Some dairy programs signpost to these rather than reproducing them. As awareness has grown this has also enabled the dairy industry to identify trends and potential gaps which need to be filled in their rural communities. For example reminders to get your skin checked only work if there is a service to do this. Bringing health professionals to field days attended by farmers has been an efficient use of resources.

The Sustainable Farm Families program (now from the National Centre for Farmer Health) has clearly demonstrated the long-term impacts and benefits of awareness-raising interventions around farmer health.

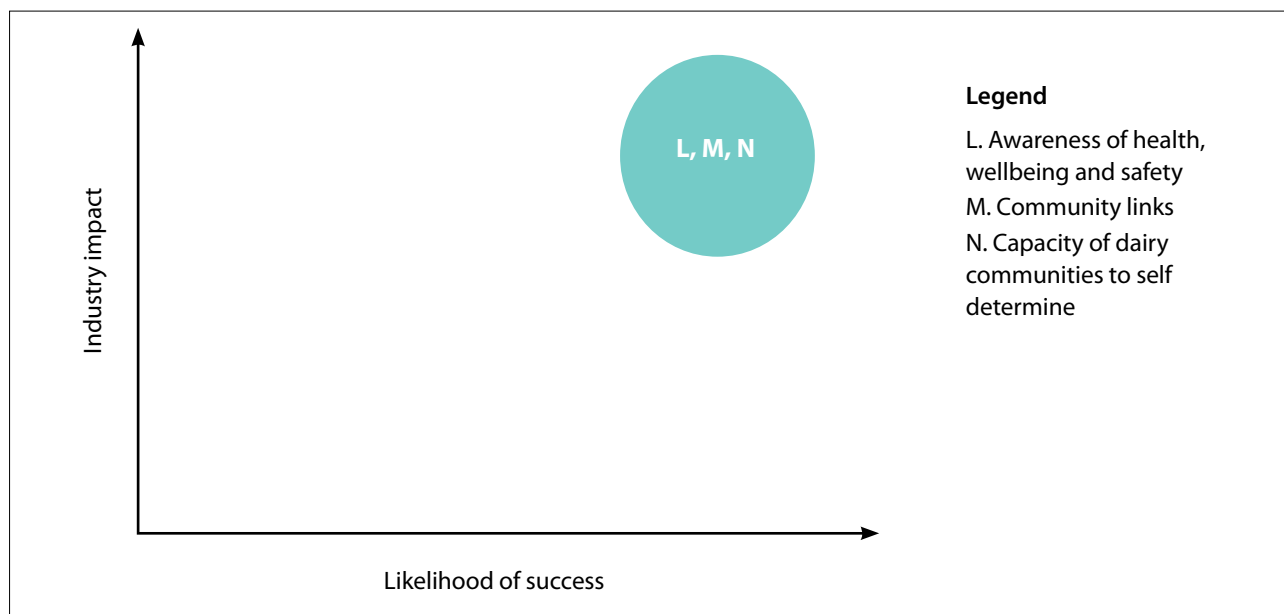
Recent research by the Gardiner Foundation has been exploring ways of extending the forms of social connectedness and capability in local communities in dairy regions and has led to the development of a pilot program to strengthen small dairy communities.

Table 8. Capabilities: Theme 4 Farmer well-being in supportive communities

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		Health yes Networks yes
Do these people and organisations represent the majority of prior learning in this area?		Non-dairy sources important to be explored
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		Rural health usually invested in by others but evidence from SSF is yes Strong networks are also an enabler for all the other RD&E
Would the collaborators be able to provide diverse avenues for change?		
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		



Figure 6. Industry impact: Theme 4. Farmer well-being in supportive communities



\* Dependent of course on resource allocation

## 9. Theme 5: Dairy leadership development

### The need

#### The industry needs:

- Leaders, governance and understanding that enables it to effectively influence public policy and manage collective investments.
- A culture of enquiry and openness, a network of 'places' where questions that are raised go for consideration.
- Who for. People and organisations across the industry spectrum (from respected farmers modeling effective change, to lead figures and organisations helping grow communities, to governance by peak bodies)
- Others who need to be involved in the development: national and state level farmer organisations, Gardiner Foundation, Regional Development Programs, dairy processing companies, Herd Improvement organisations, large farm businesses, and other investors in dairy leaders.

### Rationale

#### The industry is made up of a collective of assets and interests.

The need for leadership development across the whole value chain of the Australian dairy industry has never been greater than today. Large opportunities and risks lie ahead in an increasingly complex environment and the ability to coordinate resources appropriately will be one of the keys to industry resilience.

To have the leaders it needs into the future, the industry must have new people constantly introduced to leadership development opportunities and roles, and opportunities for those who are already leaders to further develop their skills. There are issues of not only the capacity of individuals to respond to increasing complexity in leadership roles, but also the number of people available to call on.

A number of stakeholders already invest (see the table on Existing RD&E). Having alignment across the industry would increase the efficiency and effectiveness of this investment.

### Current knowledge and capacity

In 2009 an industry blueprint for the desired outcomes and approaches in dairy leadership was developed.<sup>29</sup> It was estimated that there are approximately 200 required leadership roles across the industry and that 40 new people are needed for these roles each year. To achieve this capacity more than 80 people must have the opportunity to build their skills in leadership each year across three 'tiers' of leadership (district/regional, or state/national, or international roles). This requires a significant total investment each year from a variety of industry and external sources.

<sup>29</sup> The strategy was developed by Dairy Australia, Australian Dairy Farmers, the Gardiner Foundation, Regional Development Programs, state dairy farmer organisations, the National Centre for Dairy Education Australia and interested individuals

### Investment priority areas

**O. Establish an industry-agreed strategy for leadership development (based on the current industry blueprint)**

**P. Increase awareness of the value of leadership across the supply chain**

**Q. Ensure sufficient opportunities for leadership development are available**

**R. Support industry organisations to provide good environments for new leaders**

- Provide people who undertake leadership development training with on-going support such as mentoring and opportunities to fulfill real roles.

Table 9. Capabilities: Theme 5. Dairy leadership development

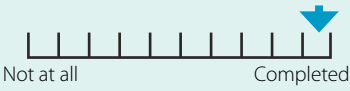
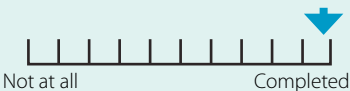



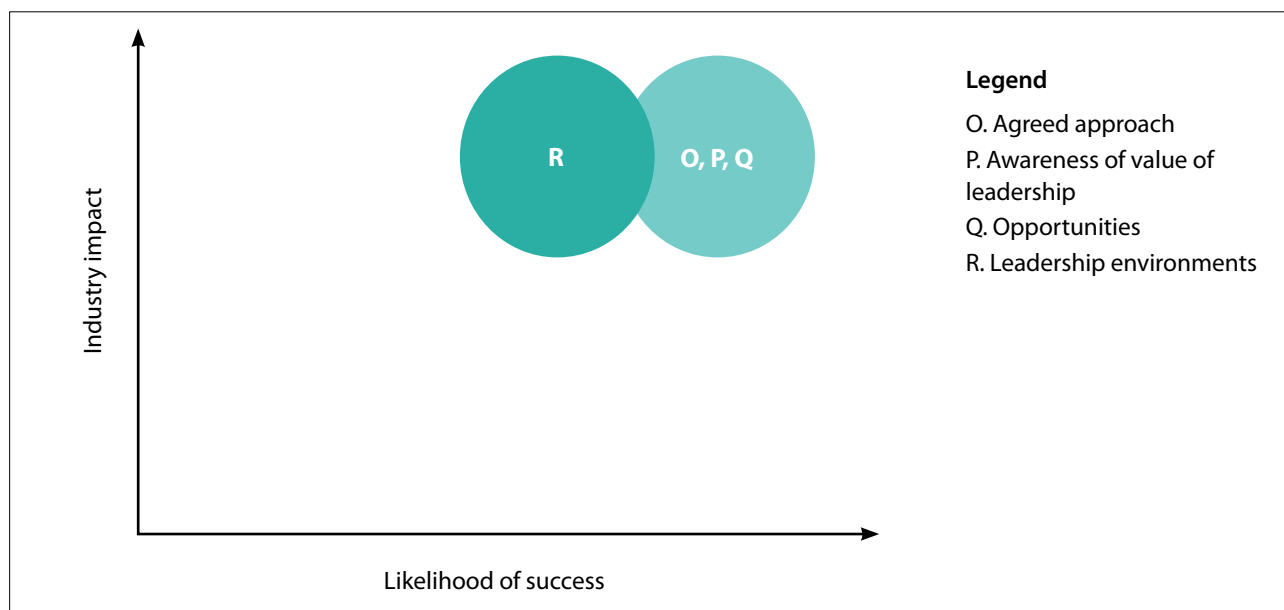
Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		
Do these people and organisations represent the majority of prior learning in this area?		
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		
Would the collaborators be able to provide diverse avenues for change?		
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		

Figure 6. Industry impact: Theme 5. Dairy leadership development



\* Dependent of course on resource allocation



# DAIRY MOVING FORWARD

Farm business management

## FARM BUSINESS MANAGEMENT RD&E STRATEGY



## Acknowledgements

**This National Strategy for Dairy RD&E in ‘Farm Business Management’ has been developed as an activity of Dairy Moving Forward—a dairy industry initiative to develop a strategy and capability plan to guide investment in pre-farmgate RD & E. It has involved extensive stakeholder consultation with representatives from the dairy industry, government, and the providers and funders of dairy RD& E.**

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## 1. Executive Summary

Good Farm Business Management (FBM) practices are important to ensure that Australian dairy farms remain profitable, and internationally competitive in a challenging operating environment. Maintaining profitability in an environment with significant variability in the value of inputs and outputs, a continuation of the ‘cost/price’ squeeze, and pressure to reduce the environmental footprint, will require farm management teams to have good knowledge of dairy farm systems and good decision making processes.

The challenge of ensuring adequate FBM practices to maintain and increase profit in the future is addressed in this FBM RD & E strategy.

The industry outcome that this strategy aims to achieve is:

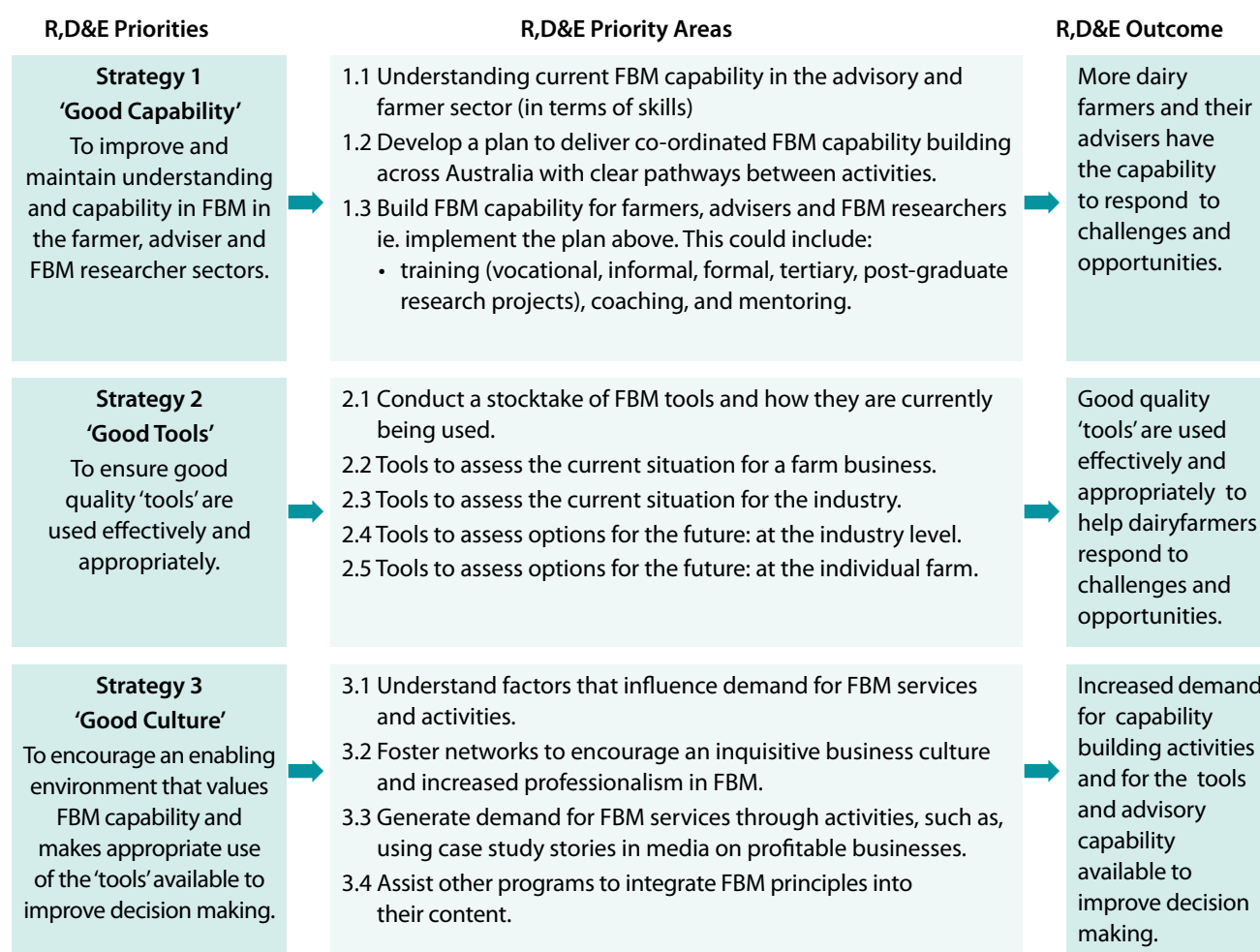
- *To have more dairy farmers respond to challenges and opportunities confidently because they have a rigorous process for analysing and making decisions that increase profit under conditions of variability and uncertainty.*

The FBM strategy consists of 3 interdependent sub-strategies. The 3 sub-strategies have lower order outcomes that will contribute to achieving the industry outcome.

- **Strategy 1: ‘Good Capability’**—To improve and maintain understanding and capability in FBM in the farmer, adviser and FBM researcher sectors.
- **Strategy 2: ‘Good Tools’**—To ensure good quality ‘tools’ are used effectively and appropriately.
- (The term ‘tools’ is used here to describe more than software, it includes approaches)
- **Strategy 3: ‘Good Culture’**—To encourage a culture that values FBM capability and makes appropriate use of the ‘tools’ available to improve decision making. The desired outcome of this strategy would be increased demand for FBM capability building activities and for the tools and advisory capability available.

Figure 1. Farm Business Management—Industry Outcome.

*More dairy farmers respond to challenges and opportunities confidently because they have a rigorous process for analysing and making decisions that increase profit under conditions of variability and uncertainty.*



Strategy 1 (Good Capability) was the highest priority identified and would require the most substantial investment over a reasonably long period of time. The multidisciplinary nature of FBM, and the complexity of dairy farming systems, means that individuals need involvement in a combination of education, practical experience and reflective activities to build the desired FBM capability.

Strategy 3 (Good Culture) was identified as being important in achieving the industry outcome by ensuring the demand for the improved FBM capability was generated. However, it was not expected that Strategy 3 would require such a substantial investment as Strategy 1.

The highest investment priorities within Strategy 2 (Good Tools) related to effective and appropriate use of tools. The industry was considered to generally be well serviced in terms of the tools developed. Several investment priority areas within each sub-strategy are summarized in the slide on the following page.

There is clearly interdependence with other areas of the DMF project (People, Feedbase/Nutrition, Natural Resource Management and Animal Performance).

### Explanation of outcome statement

- The term 'confidence' refers to confidence based on capability. Confidence without capability would not be valuable.
- The term 'rigorous process' refers to consideration of the broad range of perspectives relevant to a farm system and application of Farm Management Economics principles. Information to base the decision on will not be perfect, hence the process needs to be rigorous rather than precise.
- While the focus is on how 'dairy farmers respond', it is clear that FBM decisions are often analysed in the context of a 'management team', which may include advisers. Hence, the capability building is focused on the FBM profession as a whole, rather than solely on dairy farmers.

A more quantitative industry outcome would be that:

- Resources invested on more dairy farms earn a return on capital of 11%, which would generally be considered commensurate with investments of similar variability (3–4% to compare with minimal risk investments + 4–5% to account for the variability in returns for dairy farming + 3% for inflation). The return on capital goal enables dairy farm businesses to be compared relatively simply to alternative uses of the resources invested in dairying, but provides a somewhat narrow reflection of the motivating factors for dairy farm businesses. Clearly a return on capital of 11% would be an ambitious goal for many farms. In some locations it may be argued that greater potential for capital gains in land values may compensate for a lower return on capital for the dairy operation.

## 1.1. Context for Developing the Farm Business Management Strategy

### Background and Scope

The Dairy Moving Forward (DMF) initiative involves developing a national pre-farmgate RD & E strategy and capability plan for the Australian dairy industry. A report completed in September 2009 titled 'Dairy Moving Forward: A National Research Development & Extension Strategy' provided the strategic context and priorities for the RD&E strategy. The following five strategic priorities were developed for consideration:

- **Feedbase:** Developing the skills and knowledge that allow retention and management of an internationally competitive feedbase in a changing climate
- **Animals:** Driving animal performance
- **People:** Increasing the skills and capacity of people; aggressively developing industry education and training options
- **Sustainable natural resources:** maintaining access to key production resources
- **Farm Business Systems/Management:** Assisting farm businesses to adapt to a demonstrably more volatile business/climatic environment; developing the skills of farmers to manage that volatility.

The Farm Business Management/Systems area was considered a high priority because improved understanding of Farm Business Management principles is critical in providing the necessary skills to adapt to the volatile climatic and economic operating environment.

The scope for the Farm Business Management (FBM) area of DMF was defined as follows:

To improve FBM in the R, D, E and farmer sectors so that more dairy farmers respond to challenges and opportunities confidently because they have a rigorous process for analysing and making decisions that increase profit under conditions of variability and uncertainty.

### Definition of Farm Business Management

The development group considered the following definition a reasonable representation of what Farm Business Management (FBM) entails. "*Farm Business Management is the process by which resources and situations are manipulated over time by the manager of the farm system in trying, with less than full information to achieve their goals*" (Dillon 1980). The key limitation of the above definition is the focus on an individual 'manager' (Paine and Morrison 2010). Replacing 'manager' with 'management team' would probably give a better reflection of how many dairy farm businesses currently operate (Weise et al. 2005). The 'management team' may

include advisers, in addition to family members and employees. Most FBM decisions require integration of knowledge from a range of disciplines or perspectives, which is likely to be better represented in a team than an individual.

The following table provides some further clarification as to what the development group thought FBM entailed.

Table 1. Farm Business Management Definitions.

FBM is mostly about:	FBM isn't much about:
<ul style="list-style-type: none"> <li>Decisions to achieve goals in the future.</li> </ul>	<ul style="list-style-type: none"> <li>Looking at past performance.</li> </ul>
<ul style="list-style-type: none"> <li>Marginal return/responses to changes.</li> <li>What would an <b>extra</b> cow do to profit?</li> <li>What would an <b>extra</b> kg of grain do to profit?</li> <li>What would an <b>extra</b> 40ha do to profit?</li> </ul>	<ul style="list-style-type: none"> <li>Average responses to change in inputs.</li> <li>Linear responses to changes in inputs.</li> </ul>
<ul style="list-style-type: none"> <li>How can I increase profit and return on capital from <b>my</b> resources?</li> </ul>	<ul style="list-style-type: none"> <li>How does my performance compare to someone else or the 'average farm'?</li> </ul>
<ul style="list-style-type: none"> <li>Adequate net cash-flow to operate, called liquidity.</li> </ul>	<ul style="list-style-type: none"> <li>Cash-flow alone.</li> </ul>
<ul style="list-style-type: none"> <li>Considering the combination of cash, profit, wealth creation and risk perspectives.</li> </ul>	<ul style="list-style-type: none"> <li>Profit or wealth creation alone, or only under typical circumstances.</li> </ul>
<ul style="list-style-type: none"> <li>Whole farm thinking. (Earnings Before Interest and Tax, Return on Capital, Return on Equity, debt to equity, debt servicing ability, net worth).</li> </ul>	<ul style="list-style-type: none"> <li>Partial measures of input-output performance, eg. per cow, per ha.</li> </ul>

Table 2. Effective Farm Business Management Capabilities.

For farmers	<ul style="list-style-type: none"> <li>Understand and use operational, tactical and strategic plans.</li> <li>Understand why and when to use cash and profit analyses.</li> <li>Understand marginal responses/returns to extra inputs.</li> <li>Understand interactions and trade-offs between components of the farm business/system.</li> <li>Understand variability, risk and uncertainty in their business and how to manage the challenges and take advantage of the opportunities.</li> <li>Understand how the above applies to their unique situation.</li> <li>Understand when and how to source relevant external expertise and the ability to filter and integrate the knowledge acquired from a range of sources and apply it to their unique situation</li> </ul> <p>(Note: not necessarily managing a large or overly complicated business)</p>
For advisers	<ul style="list-style-type: none"> <li>Understand and use operational, tactical and strategic plans.</li> <li>Understand why, when and how to use cash and profit analyses.</li> <li>Understand marginal responses/returns to extra inputs.</li> <li>Understand interactions and trade-offs between components of the farm business/system.</li> <li>Understand variability, risk and uncertainty in their clients businesses and how to manage the challenges and take advantage of the opportunities.</li> <li>Understand how the above applies to the unique circumstances of the range of farm businesses that they deal with.</li> </ul>

## Approach to developing the strategy

A 'Situation Analysis' was completed, which involved a review of relevant literature and consultation with key people.

A workshop to develop the FBM strategy was held on July 15 2010 involving participants with expertise in FBM. A draft strategy was developed following the first project development meeting on July 15. Consultation following the development of the draft strategy identified an opportunity to collaborate with NZ who have been working to address similar concerns in the FBM area for some time.

A workshop on August 23rd with representatives from the other areas of DMF identified many linkages between the FBM area and the other areas in DMF.

A workshop on September 23rd enabled input into the possible areas of collaboration with NZ from a range of people involved in the Australian dairy industry.

Wider consultation with people representing milk factories, banks, universities and other agricultural industries was also conducted.

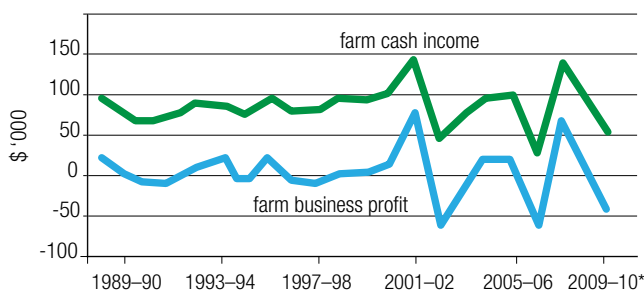
## 2. Strategy 1. 'Good Capability'—To improve and maintain understanding and capability in FBM in the farmer and service provider sector

### 2.1. Statement of need

Dairy farm businesses are operating in a volatile environment (physical, economic, policy) with a gradual 'cost/price squeeze' occurring over time. This environment requires excellent decision making processes to maintain profitability. Dairy farm business profits have been relatively volatile in the last decade (see Figure below) due to factors, such as drought and deregulation. There has been significant variation in climatic conditions, milk price and input costs—both between and within years. These conditions have led to increased pressure for adjustment in many areas of Australia. When the operating conditions are stable, many farms will operate with input levels at a point where the marginal return comfortably exceeds the marginal cost and milk price and input costs could change slightly without the marginal cost exceeding the marginal return. In these circumstances 'rules of thumb' (eg "we don't apply more than X kg N/ha/year" or "we don't feed more than X kg grain/cow/year") can substitute for a good understanding of response functions. However, in a volatile operating environment such 'rules of thumb' are a dangerous substitute for understanding response functions and economic principles, as the marginal cost can exceed the marginal return at a previously 'safe' level.

This volatility creates opportunities as well as risks. However, making the most of opportunities requires a good understanding of response functions to inputs, marginal returns/marginal costs, trade-offs between investments and excellent timing in the implementation of decisions. The variability associated with investment options available within dairy farm businesses is often not well defined. Improved clarity regarding the variability associated with investment options would enable better alignment of risk preferences of managers and risk profiles of businesses.

Figure 1. Dairy industry income vs profit



(source: ABARE 2010)

Pressure to minimize environmental impacts and meet community expectations will place further emphasis on understanding dairy farm systems and FBM. Maintaining profit while reducing environmental impacts will not occur unless farm management teams have a good understanding of response functions and interactions between different inputs and the many components of the farm system.

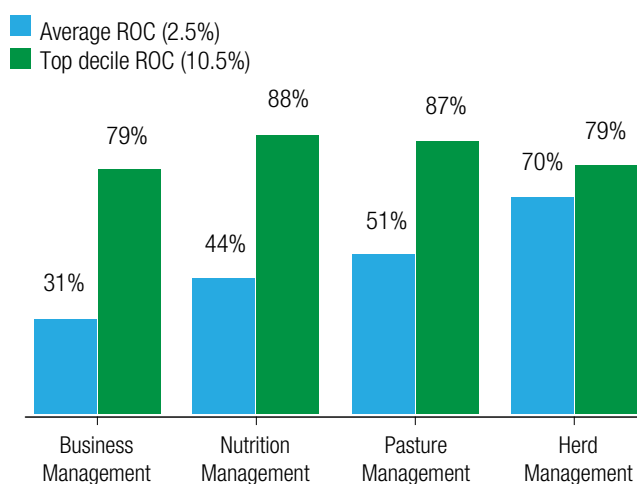
Management systems for dairy farms are extremely complex and have to deal with large numbers of variables, such as, climate, irrigation, pasture management, grazing management, supplementary feeding, animal health, milk harvesting and changing commodity prices (Armstrong et al 2003). The complexity exists because the systems deal with biological, environmental, human and economic systems in which interactions are non-linear, often incompletely understood, influenced by multiples of other variables and subject to substantial variation over time. Management systems are made even more complex by the need to incorporate the personal characteristics of the user, including individual perceptions of risk. While changes may initially appear straightforward, implementing such options will generally impact on

a number of areas of the farm business. For example, increasing pasture consumption may require an increase in stocking rate and herd size on some farms. Replacement of existing infrastructure, such as, the dairy, may be required if herd size increases and an investment in infrastructure such as this will generally result in a review of the longer-term plans and strategic directions for the farm business.

Australian dairy farm systems are also extremely diverse, both within districts and between districts. 'Recipe' type approaches are unhelpful in such situations where good decision making requires interpretation of the information available within the unique circumstances of the individual business.

Anecdotal evidence from the last few years would suggest that some farmers have an adequate set of FBM skills to respond appropriately to the challenges and opportunities that arise from the volatile environment. Other farmers have struggled to respond to challenges due to limited FBM capability. (For those with good FBM skills, the operating environment doesn't control their business performance, they take responsibility for the performance of their farm). A study of dairy farm businesses in Tasmania found that business management skills was one of the skill areas that had the strongest association with superior returns on capital (see Figure 2) (Davey and Maynard 2009). A potential impediment to progress in this area is that experience is often valued much more than education in the farmer sector.

**Figure 2. Skill by Management Area**  
(for average and high return on capital farmers)



### RD & E capability in FBM in the Australian dairy industry

A recent survey of R, D & E capability for the Australian dairy industry found that FBM capability is limited (Peverill and Oates 2010).

- Majority who responded were in the E area, few in the R & D area
- Majority who responded were in the over age 40 bracket
- Private sector was heavily represented.

They suggest that demand may increase for skills in agricultural economics, business and financial management, and integrated systems modelling.

This survey (Peverill and Oates 2010) gives no information regarding the competency/skills of the people surveyed. This is likely to be a more important limitation than the quantity of people available in the R, D and E sector.

This survey also probably underestimates the problem in that the number of tertiary institutions that provide training in the FBM area have declined markedly in recent years. There are few remaining Universities in Australia that currently offer FBM training (partly due to low enrollments). Hence, it will be difficult to recruit graduates with training in this area in the future. The lack of tertiary contribution also impacts on the overall professionalism in the FBM area. The small market size, and lack of critical mass in FBM in tertiary institutions, may make it difficult to address this 'capability crisis' without overseas collaboration.

The lack of FBM capability is not a problem unique to the dairy industry in Australia. A lack of capability in FBM was identified across all Australian agricultural industries in a recent review (Krause 2010). Cross industry investment in developing better FBM capability may be beneficial, but would need to recognize the variation in farm systems issues between industries.

The trans-disciplinary nature of FBM makes it challenging to foster the discipline (Paine and Morrison 2010). There is also a need to ensure that 'trans-disciplinary' doesn't lead to 'no discipline' (Malcolm unpublished). A study by Weise et al. (2005) found that people working in the FBM area did not have a unified understanding of their specialization, or a common definition of what FBM involved. Hence, it is important to have effective networks, peer reviewed publications and professional development opportunities if a healthy profession is to flourish (Paine and Morrison 2010).



There is little data available on service provider's skill levels in FBM, and the setting of directions for the future could benefit from further information in this area. There is also not a widely recognised level of formal accreditation in the FBM area. The Australian Institute of Agricultural Science and Technology (AIAST) has a specialist section for consultants (Australian Association of Agricultural Consultants (AAAC)) to advance the profession. The AIAST offer Certified Practising Agriculturalist (CPAg) accreditation, which is basically recognition of professional development activities undertaken, and AgCredited, which involves completing coursework in competencies, such as Rural Business Management. AgCredited has been running for several years and is currently under review.

The capability to provide input from the FBM profession into other research areas is critical to inform research directions and add value to other research areas by providing context to results (Black 2005). When whole farm systems analysis is combined with elements, such as expert panels and case study farms, it can provide a unique opportunity to integrate knowledge from a range of sources (farmers, researchers, advisers, policy) (Malcolm unpublished). The FBM research capability contributes to the overall profession by setting 'Rolls Royce' standards of farm business analysis and investigating emerging approaches to analysis. The operating environment is changing and complex, necessitating revisiting established ways of thinking and exploring new approaches to analysing resource utilisation, allocation and risk. This capability appears to be developing to a reasonable level (Peverill and Oates 2009), with a significant amount of the capability in DPIV and University of Melbourne.

### **Lack of coordination across Australia**

There has been significant investment in the area of FBM for the dairy industry in the last two decades. Many projects have been of high quality eg MilkMap (Weise 2004), and achieved significant benefits. However, there appears to have been a lack of co-ordination between activities across regions of Australia. This may have significantly limited the return on the funds invested.

Dairy Business Focus was an exception in that there appeared to be good co-ordination across regions. However, this program suffered from other limitations, including pathways between activities not being clear to participants (Weise et al. 2005).

A possible reason for the lack of co-ordination is that there is often little incentive for the private sector to share skills and resources and act in a co-ordinated

manner as some see themselves as being in competition with others. State boundaries are also an impediment to co-ordinated approaches.

### **New Zealand situation**

The New Zealand situation is similar to Australia in that they are experiencing a loss of FBM expertise at several levels: on farm, amongst advisors, and within the higher education institutes. Dairy NZ have allocated funds to building capability in FBM. A key first step is to establish a Centre of Excellence in FBM involving Lincoln and Massey Universities, AgITO and other organisations. The Centre of Excellence would include: a post graduate research program; a professional development program for farmers and advisers; and interface with academic and vocational training organisations to adapt their education and training programs to satisfy demands from industry. The Centre of Excellence would seem to be a logical point of collaboration between NZ and Australia.

Many of the investments proposed in this document could have an increased return if conducted in collaboration with other countries.

## **2.2. Rationale**

Investment in the capability and skills of the farmers and service providers, will increase the number of farmers who respond appropriately to the challenges and opportunities that arise from the volatile environment, increase profit and achieve more of their goals. A diagram representing the logic of the rationale is provided in Appendix 1.

- The investment needs to be based on a robust strategy for the Australian dairy industry that is coherent and well co-ordinated across the country.
- Identifying pathways for participants in activities to progress through the various activities required to build their knowledge, capability and confidence will be important.

## **2.3. Existing investment activities & key past investments**

There have been a range of investments in this area over time (for details refer to Weise et al. 2005). In recent times DPI Victoria have invested in short training courses in Farm Management Economics across industries for their extension staff (delivered by Bill Malcolm) and in more dairy specific training (delivered by John Mulvany). There does not appear to have been widespread investment directed at improving FBM capability in the farmer sector in recent years. There have been some regionally based projects, such as 'Dairy Business Networks' and 'In Charge',

that have been developed, but these projects have not been co-ordinated at a national level.

The Geoffrey Gardiner Dairy Foundation (GGDF) plan to invest in this area in the near future through Pillar 4 of the Flexible Dairy Business Program (FDBP). This investment will target emerging senior advisers, advanced skills advisers, and advanced skills farmers. There will be a need for additional investment to build capability across the farmer and RD & E sectors to the level envisaged in this strategy.

## 2.4. Priorities for further investment including outcomes sought (short, medium, long term)

### IPA 1.1 Understanding current FBM capability in the advisory and farmer sector

This would focus on understanding current capability FBM in terms of skills. It would build on the work reported in Davey and Maynard (2009) and would be conducted to inform future directions and investments. DairyNZ are likely to invest in this area in the near future and there would appear to be significant efficiencies from conducting this work across Australia and NZ.

### IPA 1.2 Develop a plan to deliver co-ordinated FBM capability building across Australia with clear pathways between activities.

This plan would be informed by the work conducted in IPA 1.1. The plan would aim to address a lack of coordination in the FBM area and enhance the level of professionalism in FBM.

### IPA 1.3 Build FBM capability for farmers, advisers and FBM researchers

This would involve implementing the plan above (IPA 1.2) to achieve the outcome of more farmers and their advisers having the capability to respond appropriately to the challenges and opportunities that arise from the operating environment.

Activities invested in could include:

- farmer training (vocational, informal, formal/tertiary),
- adviser training (informal, formal/tertiary)
- FBM researchers (informal, formal/tertiary, post-graduate research projects)
- Coaching and mentoring would be important for all segments.

To maximize the return on the funds invested it will be important to ensure strong links between all activities and organizations.

## Qualitative ranking of impact and likelihood of success

### IPA 1.1 Understanding current FBM capability in the advisory and farmer sector (in terms of skills)

This would be a relatively small investment over a short period of time and have a high likelihood of successfully achieving the objective of understanding current FBM capability and skill levels in the advisory and farmer sector. Investment in this area will make an important contribution towards achieving an industry impact by providing underpinning knowledge to inform directions. However, without IPA 1.2 and 1.3 this would be expected to achieve only a small industry impact.

### IPA 1.2 Develop a plan to deliver co-ordinated FBM capability building across Australia with clear pathways between activities.

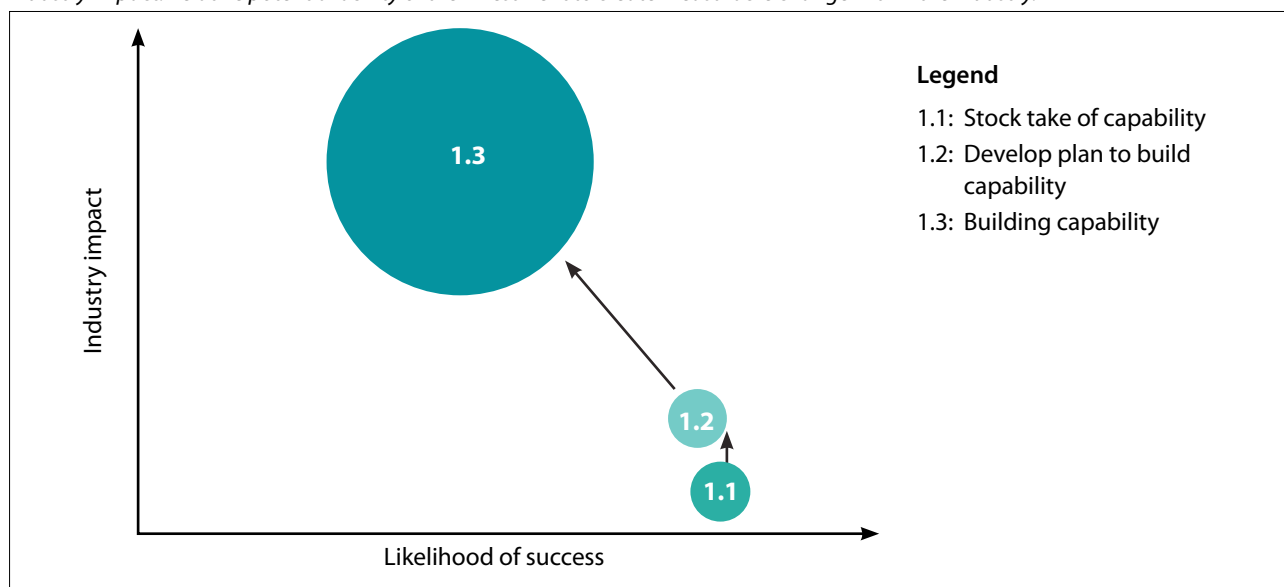
This would be a relatively small investment over a short period of time and have a high likelihood of successfully achieving the desired objective. Investment in this area will make an important contribution towards achieving an industry impact, but without being implemented (IPA 1.3) would be expected to achieve only a small industry impact.

### IPA 1.3 Build FBM capability for farmers, advisers and FBM researchers ie implement the plan above.

This would be a relatively large investment over a long period of time. It has a high likelihood of successfully achieving the desired outcome, and probably numerous other benefits to industry. Investment in this area would also be expected to achieve a substantial industry impact.

The rankings of these investments are represented in Figure 3 on the following page.

Figure 4. Likelihood of success: Judgement based on experience and review of route to market checklist below.  
Industry impact: Relative potential ability of the investment to create measurable change within the industry.



\* Estimations of impact, likelihood and scale of project are qualitative only and reflect the opinion of the Dairy Moving Forward expert working group

### Timing of Investment Priority

IPA 1.1 and 1.2 should be completed within the next 12 months. IPA 1.3 should begin within the next 1–2 years and build over the next 2–3 years.

## 2.5. Capabilities available and required

The capability available and required has been discussed in the above sections.

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		
Do these people and organisations represent the majority of prior learning in this area?		
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		
Would the collaborators be able to provide diverse avenues for change?		
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		

## 2.6. Route to market considerations

In this area the route to market is direct, with the investment focused on the end users.

### 3. Strategy 2. ‘Good Tools’—To ensure good quality ‘tools’ are used effectively and appropriately

#### 3.1. Statement of need

In this document the term ‘tools’ – is referring to more than software, it includes approaches. The development of ‘Good Tools’ is often seen as the solution for FBM challenges. However, there is considerable evidence to suggest that effective and appropriate use of the tools is more important than the tool itself (Black 2005, McCown 2002, Woodward et al. 2008, Cox 1996). Hence, the high priority investments in this strategy relate mainly to promoting effective and appropriate use of existing tools, which is strongly linked to Strategy 1 ‘Good Capability’. (Some of the discussion in the following section relates to outlining what is not a high priority investment).

To provide some structure to this area of ‘tools’ we have divided it into the following 4 sections:

1. Tools to assess the current situation for a farm business
2. Tools to assess the current situation for the industry.
3. Tools to assess options for the future: at the industry level
4. Tools to assess options for the future: at the individual farm

#### Tools to assess the current situation for an individual farm business

Analysis of data on the past performance of a farm business is unlikely to be an appropriate tool for making farm management decisions (Ferris and Malcolm 1999), but can contribute to creating demand for FBM services. Farm management decision making is about deciding on the most effective use of resources on a farm to achieve the objectives of the farm business in the future (Dillon 1980, Makeham and Malcolm 1993, Ferris and Malcolm 1999). Analysis of the current situation can be useful in indicating potential areas for improvement of the farm business. However, such data needs to be interpreted with an excellent understanding of farm systems and the unique resources of the individual farm. The development of tools in this area is currently well serviced through programs, such as Taking Stock and Red Sky. Training in appropriate use of these tools is a much higher investment priority than further development.

#### Tools to assess the current situation at the industry level

A substantial amount of the investment in the dairy industry has been in benchmarking programs, which are unlikely to result in farmers making better FBM decisions if the program is operating in isolation. Investment in

this area is unlikely to directly lead to an outcome of increased profitability and it is not consistent with the definition of FBM outlined earlier in this document. However, if it can impact on improving capability and demand for FBM services it could have an indirect impact on farm profitability. (Add evaluation of DairyBase findings). Industry benchmarking data can be effective in developing a broad understanding of the industry issues (Burns 1966). Hence, investment in this area will also be of value in informing policy development.

#### Tools to assess options for the future: at the industry level

Some of the whole farm systems analysis approaches in this area form a key plank in the FBM research. When whole farm systems analysis is combined with elements, such as expert panels and case study farms, it can provide a unique opportunity to integrate knowledge from a range of sources (farmers, researchers, advisers, policy). Investment in this area makes a number of important contributions that are not directly linked to the FBM outcome. There is a need to invest in approaches that set the ‘Rolls Royce’ standard for analysis and raise the standard and professionalism of the FBM profession. Principles can be extrapolated from more sophisticated approaches to inform the use of simpler approaches at a farm level.

Some of the whole farm systems analysis approaches have a key role in informing research priorities (Black 2005) and in integrating knowledge from a range of sources. While this does not directly link to the FBM outcome, it forms a vital role in contributing to the overall effectiveness of the DMF strategy by increasing return on investment from across the various areas of DMF. This type of work also has an important role in informing policy development. This area is reasonably well serviced in Victoria through the Dairy Directions project, but does not appear to be so well serviced in other States.

#### Tools to assess options for the future at the individual farm level

It may seem reasonable to expect that a decision support system may be useful to a farmer considering options to improve profit. However, use of DSS by farm managers has generally been low across a range of agricultural industries in Australia and New Zealand (McCown 2002, Woodward et al. 2008). The complexity of farm management decisions are actually best served by relatively simple tools and very sophisticated thinking (Ferris and Malcolm 1999) so that the assumptions

are clear to all of the farm management team. For this reason most advisers prefer to construct their own tools (Black 2005) and often prefer to custom build them in consultation with the client to provide transparency, understanding and ownership. This highlights the importance of investing in the development of capability of service providers if the quality of tools and services are to be maintained and improved.

While decision support systems are unlikely to be widely used by dairy farmers, and thus there are risks associated in investing in the development of such tools, investment in this area may still deliver substantial benefits to the dairy industry, providing the process for developing it is sensible.

What would such a process consist of? It would need to include the following features:

- Involvement of end users in the development (McCown 2002, Woodward et al. 2008)
- Recognise that the learning that occurs during the developing is likely to be as useful as the tools themselves (Cox 1996). Hence, the involvement of end users in the development is critical in ensuring the learning often reserved for the developer is shared with end users
- Multidisciplinary involvement in development from across RDE and farmer sectors
- A focus on getting the questioning right (Gibb 2001)
- Adequate transparency so that assumptions can be challenged
- Give consideration to the diversity between farms in resources, skills and objectives.

### 3.2. Rationale

Investment in ensuring sound FBM approaches to analyses and good 'tools' are recognized, disseminated, and used effectively will increase the number of farmers who respond appropriately to the challenges and opportunities that arise from the volatile environment and achieve more of their goals.

### 3.3. Existing investment activities & key past investments

#### IPA 2.1 Conduct a 'stocktake' of FBM tools and how they are currently being used

Some studies have investigated decision support tools in the FBM area (eg Black 2005), but a 'stocktake' of how the available tools are currently being used would provide useful information to inform future activities. DairyNZ are likely to invest in this area in the near future and there would appear to be significant efficiencies from conducting this work across Australia and NZ.

#### IPA 2.2. Tools to assess the current situation for a farm business

There has been industry and private sector investment in this area in terms of developing tools eg Taking Stock, Red Sky. There initially was a significant investment in training to make appropriate use of the Taking Stock tool, but there is currently little investment in this area.

#### IPA 2.3. Tools to assess the current situation for the industry

The Dairy Farm Monitor project aligns with this area in Victoria, and QDAS in Queensland. ABARE surveys also contribute to this area. The Geoffrey Gardiner Dairy Foundation (GGDF) plan to invest in this area in the near future through Pillar 3 (Australian National Dairy Database) of the Flexible Dairy Business Program (FDBP).

#### IPA 2.4. Tools to assess options for the future: at the industry level

The Dairy Directions/Modelling Dairy Farm Systems project services this area in Victoria through investment by DA and DPIV in this area. This work is represented in Pillar 2 in the FDBP. Having similar capability and tools available in other States would be desirable.

Pillar 1 in the FDBP (Sustainable Milk Production) also aligns with this area to some extent.

#### IPA 2.5. Tools to assess options for the future: at the individual farm

Pillar 1 in the FDBP will contribute through the development of a detailed tool (Sustainable Milk Production).

Investment in developing the skills to use relatively simple tools with sophisticated thinking is likely to provide a high return (this links closely to IPA 1.3). Pillar 4 (Skills enhancement) of the FDBP will also contribute to this area.

### 3.4. Priorities for further investment including outcomes sought

#### IPA 2.1 Conduct a 'stocktake' of FBM tools and how they are currently being used.

The outcome of investment in this area would be to inform future activities regarding the use and development of FBM tools.

#### IPA 2.2 Tools to assess the current situation for a farm business

The emphasis in IPA 2.2 would be on developing the capability to make appropriate use of existing tools, as a preliminary step to analyzing options for the future.



### **IPA 2.3 Tools to assess the current situation for the industry**

Investment in this area is unlikely to directly lead to an outcome of increased profitability, but may increase demand for FBM services.

### **IPA 2.4 Tools to assess options for the future: at the industry level**

Key outcomes from investing in this area are to set a 'Rolls Royce' standard for FBM analysis and foster professionalism in FBM. There are reasons for investing in this area other than directly improving FBM practices eg informing and adding value to other research areas, and informing policy.

### **IPA 2.5 Tools to assess options for the future: at the individual farm**

The outcome sought from investment in this area is to increase the number of farmers who respond appropriately to the challenges and opportunities that arise from the volatile environment. This could be achieved through investing in capability to make effective use of simple tools, or investing in the development of complex tools to assess options for the future at the individual farm level. However, there is a marked difference in the likelihood of achieving this outcome between investing in capability to make effective use of simple tools and investing in the development of complex tools.

## **Qualitative ranking of impact and likelihood of success**

### **IPA 2.1 Conduct a stocktake of FBM tools and how they are currently being used**

This would be a relatively small investment over a short period of time and have a high likelihood of successfully achieving the desired objective of understanding how tools are currently being used. Investment in this area will make an important contribution towards achieving a significant industry impact, but without a range of other investments would be expected to achieve only a small industry impact.

### **IPA 2.2 Tools to assess the current situation for a farm business**

This would need a relatively small investment over a long period of time. This area is currently well serviced in terms of availability of tools eg Taking Stock, Red Sky so the emphasis would be on developing the capability to make appropriate use of these tools, rather than further development. The likelihood of success in developing the capability to make appropriate use of

existing tools would be high. Investment in this area will make an important contribution towards achieving a significant industry impact, but without a range of other investments would be expected to achieve only a small industry impact.

### **IPA 2.3 Tools to assess the current situation for the industry**

This would need a relatively large investment over a long period of time, if there is to be development of more sophisticated tools. There are technical challenges, participation challenges, and a high likelihood that it will often be used inappropriately for FBM decisions. This investment is unlikely to directly lead to an outcome of increased profitability, but may increase demand for FBM services and could potentially contribute to capability building. There may be reasons for investing in this area other than improving FBM decision making, e.g. informing policy.

### **IPA 2.4 Tools to assess options for the future: at the industry level**

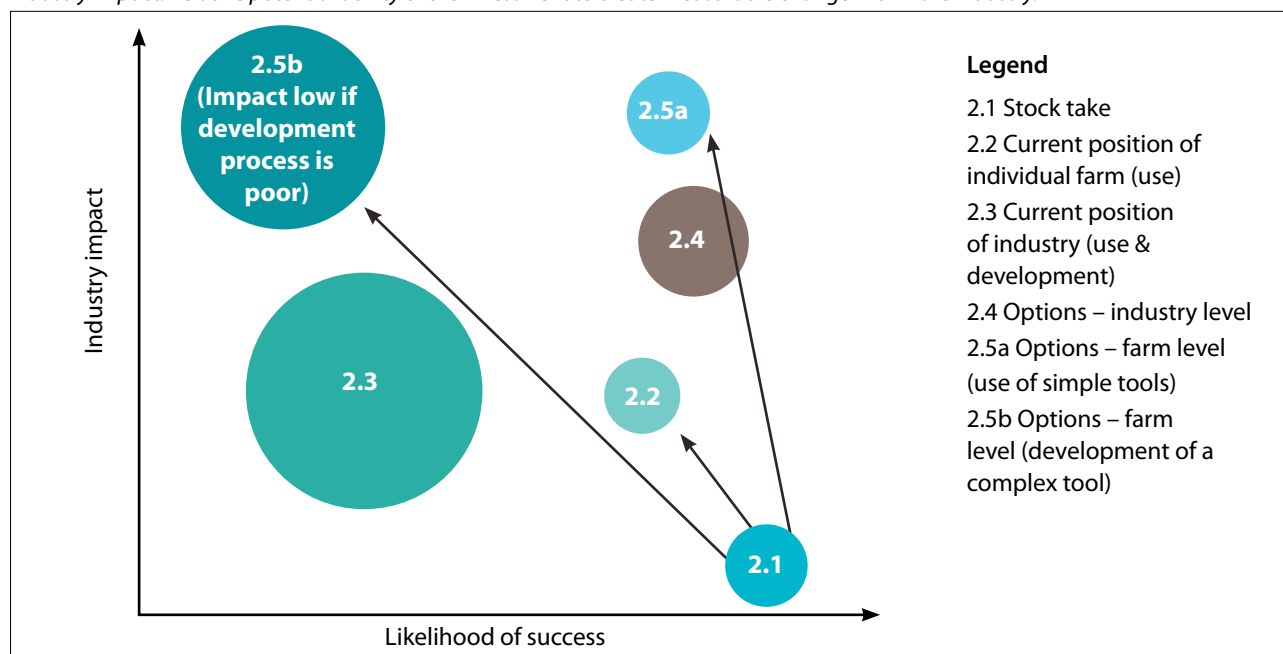
This would need a medium size investment over a long period of time. The likelihood that it would be successful is high, given the established record in this area from previous investments. This investment is likely to have a moderate industry impact, but makes a critical contribution in the FBM research area by fostering professionalism in FBM and setting a 'Rolls Royce' standard for FBM analysis.

### **IPA 2.5 Tools to assess options for the future: at the individual farm**

- a) **Effective use of simple tools.** This would need a relatively small investment over a long period of time. The emphasis would be on developing the capability to make appropriate use of relatively simple tools. The likelihood of success in developing the capability to make appropriate use of relatively simple tools would be high. Investment in this area could achieve a significant industry impact.
- b) **Development of complex tools.** This would need a medium size investment over a long period of time. The likelihood that it would be successful may be relatively low, but would be heavily dependent on the process used in the development ie significant involvement of end users. Investment in this area could have a significant industry impact if successful, and could potentially contribute to capability building depending on the development process.

The rankings for investment in this area are illustrated in Figure 5 on the following page.

Figure 5. Likelihood of success: Judgement based on experience and review of route to market checklist below.  
Industry impact: Relative potential ability of the investment to create measurable change within the industry.



\* Estimations of impact, likelihood and scale of project are qualitative only and reflect the opinion of the Dairy Moving Forward expert working group

### Timing of Investment Priority

IPA 2.1 should be completed within the next 12 months. Investments in training in the use of existing tools need to align with capability building activities (IPA 1.3) and hence should begin within 1–2 years and build up over the next 2–3 years.

### 3.5. Capabilities available and required

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		
Do these people and organisations represent the majority of prior learning in this area?		
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		In the areas focused on effective use of relatively simple tools with sophisticated thinking, it is clear that investment will provide benefits.
Would the collaborators be able to provide diverse avenues for change?		
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		

### 3.6. Route to market considerations

In terms of effective and appropriate use of tools, the route to market involves direct end user involvement.

If there is to be investment in the development of new tools, extensive consideration of the end users needs and the route to market will be required.

## 4. Strategy 3. “Good Culture”—To encourage more widespread use of the capability and tools available to improve decision making

### 4.1. Statement of need

Achieving a high return on the investment in Strategies 1 and 2 will depend on having a high demand for FBM capability building activities and for the tools and advisory capability that become available. This demand will be influenced to some extent by the operating environment. However, we see that developing a ‘supportive enabling environment’ or ‘inquisitive business culture’ is a key strategy that can influence demand for FBM services. This Strategy has a strong link to the People area of DMF.

The desired ‘supportive enabling environment’ would be defined as having the following characteristics:

- › A high demand for FBM capability building activities and for the tools and advisory capability available.
- › Encourages innovation and continuous improvement.
- › Encourages a high level of professionalism and professional development in both the farmer and service provider sectors.
- › Values education highly, as well as experience.
- › Has active, healthy and effective networks that promote the ‘inquisitive business culture’ from a grassroots level.
- › Encourages farmers to take responsibility for the performance of their business, rather than being controlled entirely by the operating environment.

The Australian dairy industry appears to have some opportunities for improvement in most of the above characteristics. A greater understanding of the current culture/enabling environment, and particularly the factors that influence demand for FBM services, would provide valuable information to inform future activities.

As discussed earlier, the trans-disciplinary nature of FBM makes it challenging to foster the discipline, and effective networks and professional development opportunities are critical for the future of a healthy profession.

### 4.2. Rationale

That investing in a ‘supportive enabling environment’ (through the priorities listed below) will increase demand for FBM capability building activities and for the tools and advisory capability available.

### 4.3. Existing investment activities & key past investments

There appears to be very little current or previous investment in this area.

### 4.4. Priorities for further investment including outcomes sought (short, medium, long term)

The key outcome sought from this strategy is increased demand for FBM capability building activities and for the tools and advisory capability available.

#### IPA 3.1. Understand factors that influence demand for FBM services and activities

The outcome sought is to understand the factors that influence demand for FBM services and activities. This would be used to inform activities that could influence demand and to help position the FBM services and activities so they are meeting the needs of the intended audience. This area will need to be developed in collaboration with the People area of DMF and social research groups.

#### IPA 3.2 Foster networks to encourage an inquisitive business culture and increased professionalism in FBM

The Regional Development Programs will play an important role in this area, as many of them have identified, established and fostered relevant networks. It will also be important to review what has been achieved through the New Zealand Young Farmers, and the Rural Womens Network. For the Australian farmer audience this could include:

- › The Young Dairyfarmer Development Program initially developed through GippsDairy
- › ‘In Charge’ the financial literacy program for women developed through WestVic Dairy

For advisers and researchers there would appear to be substantial benefits from fostering networks, such as the Australian Farm Business Management Network, to stimulate demand for professional development activities, strengthen the identity of the FBM profession and an increased level of professionalism. The Australian Institute of Agricultural Science and Technology (AIAST) may also have a role in improving the level of professionalism in FBM.

#### IPA 3.3 Generate demand for FBM services through activities, such as, using case study stories in media on profitable businesses

To ensure a good return on the investments to improve capability and effective use of tools, it will be important to effectively market and promote the availability of FBM services and activities.

### IPA 3.4 Assist other programs to integrate FBM principles into their content

The connection between FBM and other areas of dairy farming provide significant opportunities through assisting other programs to integrate FBM principles into their services and materials. This approach also assists in reaching a broader audience than just those who have a strong interest in FBM. Having an investment priority area targeted at assisting other programs to integrate FBM would ensure that this occurs in a planned and deliberate manner, rather than in a haphazard manner.

### Qualitative ranking of impact and likelihood of success

#### IPA 3.1. Understand factors that influence demand for FBM services and activities

This would be a relatively small investment over a short period of time. It would have a high likelihood of successfully achieving the desired objective of understanding factors that influence demand for FBM services and activities. Investment in this area will make an important contribution towards achieving an industry impact, but without a range of other investments would be expected to achieve only a small industry impact.

### IPA 3.2 Foster networks to encourage an inquisitive business culture and increased professionalism in FBM

This would be a need a medium size investment over a long period of time. It would have a moderate likelihood of success in increasing demand for FBM services, but may achieve a range of additional benefits. Investment in this area could make an important contribution towards achieving a substantial industry impact.

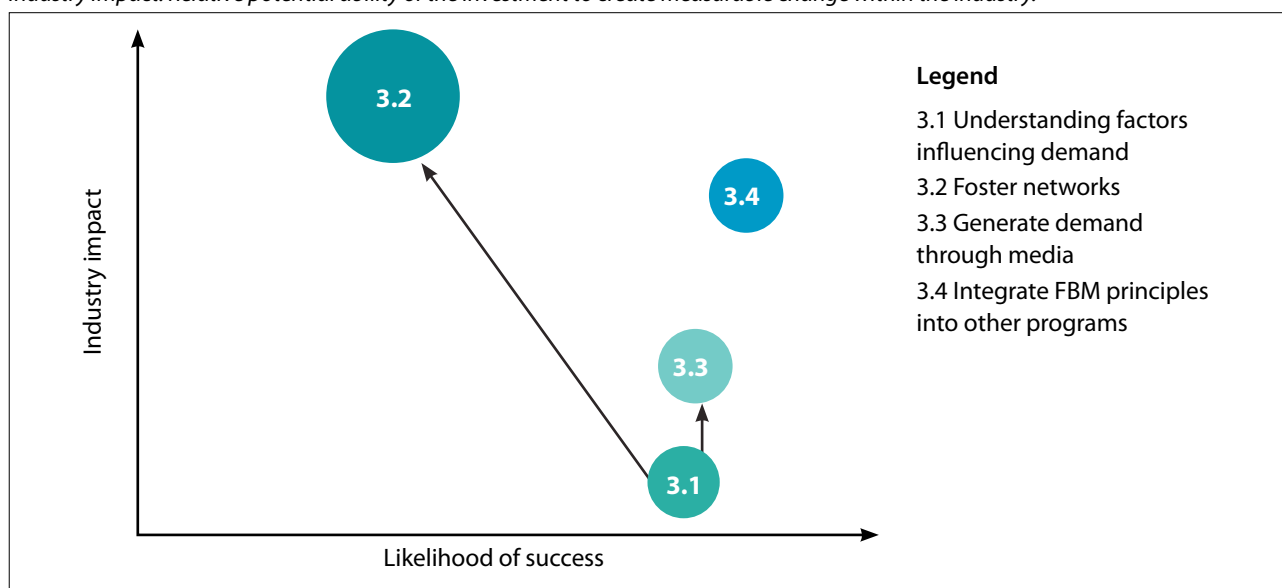
### IPA 3.3 Generate demand for FBM services through activities such as, using case study stories in media on profitable businesses

This would be a relatively small investment over a long period of time. It would have a high likelihood of success. Investment in this area could make an important contribution towards achieving an industry impact, but without a range of other investments would be expected to achieve only a small industry impact.

### IPA 3.4 Assist other programs to integrate FBM principles into their content

This would be a need a medium size investment over a long period of time. It would have a high to moderate likelihood of success in increasing demand for FBM services, and may substantially improve decision making in some cases. Investment in this area would be expected to make a moderate to high contribution towards achieving a substantial industry impact.

Figure 6. Likelihood of success: Judgement based on experience and review of route to market checklist below.  
Industry impact: Relative potential ability of the investment to create measurable change within the industry.



\* Estimations of impact, likelihood and scale of project are qualitative only and reflect the opinion of the Dairy Moving Forward expert working group






### Timing of Investment Priority

Given that the desired outcome of this strategy is to increase demand for FBM services, it needs to align with the timing of Strategy 1 and 2.

As cultural change is expected to be gradual it will be important to commence IPA 3.1 and 3.2 within the next year. Implementation of IPA 3.3 should begin within the next 1–2 years. Work on IPA 3.4 should commence within the next year.

### 4.5. Capabilities available and required

To deliver on these priority areas will require social research, practice change, communications and marketing capability, in addition to FBM expertise.

Question	Assessment	Comment
Is there a clear group of relevant organisations and people available to collaborate around this space?		
Do these people and organisations represent the majority of prior learning in this area?		
Is it clear that an investment in this area will provide benefits and outcomes for the co investors?		
Would the collaborators be able to provide diverse avenues for change?		
Is the capability present (funds, people and infrastructure) in the collaboration to deliver the specified outcome?		

### 4.6. Route to market considerations

In this area the route to market is directly targeted at the end users.



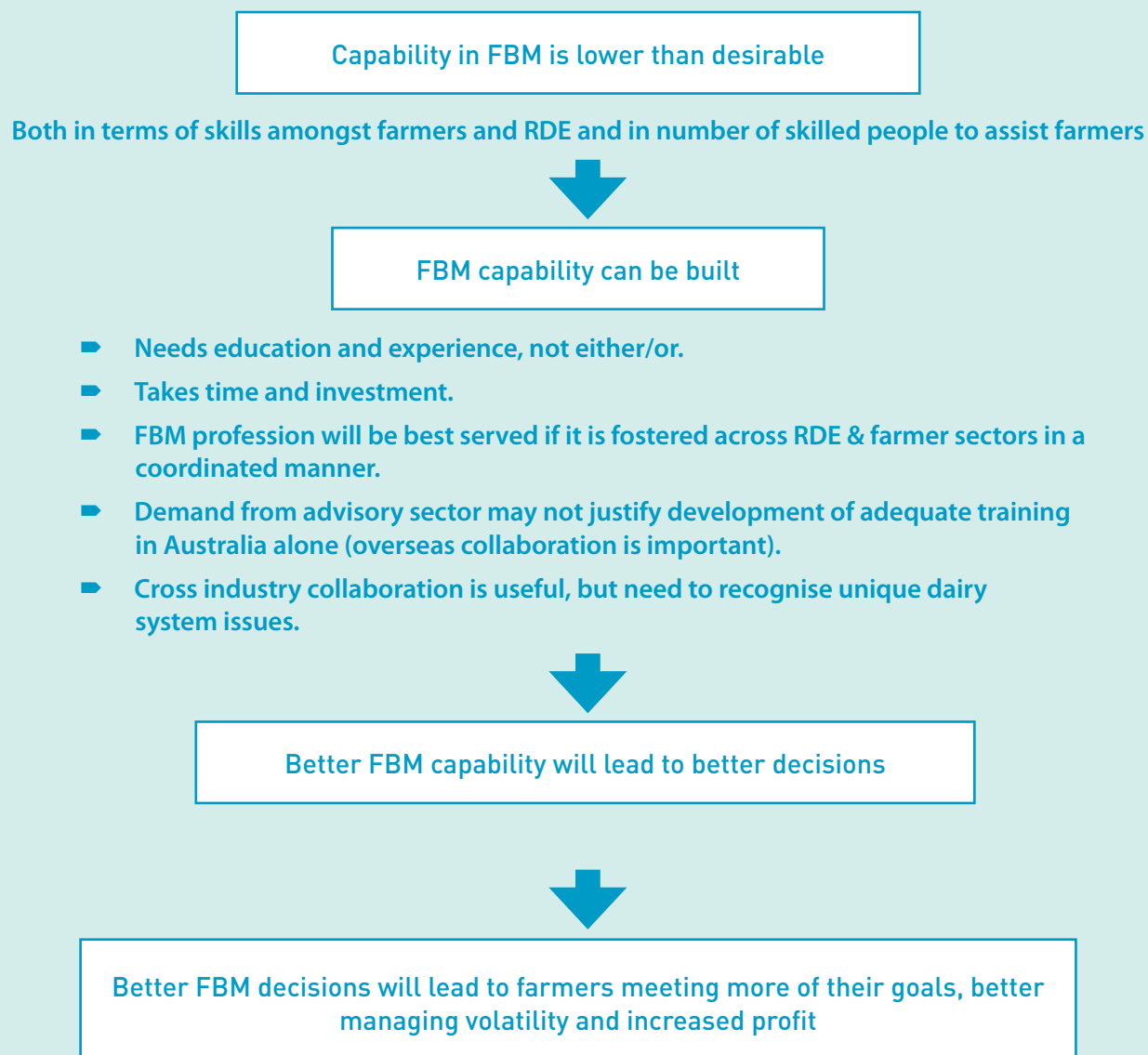
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## Appendix

### Appendix 1

#### FBM Rationale



## Appendix 2

### FBM—without intervention



# DAIRY MOVING FORWARD

Cross-linkages between priorities

## CROSS-LINKAGES BETWEEN PRIORITIES IN THE 'FEEDBASE & ANIMAL NUTRITION', 'ANIMALS' AND 'NATURAL RESOURCE MANAGEMENT' STRATEGIES RD&E STRATEGY



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## 1. Summary

This discussion paper was prepared for Dairy Australia to identify areas of overlap or mutual interest in the priorities contained in the draft Feedbase & Animal Nutrition, Animal Performance, and Natural Resource Management and Climate Change (NRM & CC) strategies of Dairy Moving Forward (DMF): A National Research Development & Extension Strategy. The purpose is to identify where synergies might exist in these overlaps or areas of mutual interest and to speculate on what this might mean in establishing priorities, and in capturing efficiencies when investing.

A perspective of farming systems and farm systems research is given to draw attention to the interconnectedness of the components of farm systems and, hence, of research, development and extension (R,D&E) into feed production and utilisation, livestock genetics, health and management and natural resource management. The proposition is put that synergies in priorities identified in the three strategies are best captured in a robust program development process, which should establish the practicalities of capturing efficiencies.

The design and conduct of a significant amount of RD&E will involve modelling, and this is reiterated in many of the priorities described in each strategy. As modelling is a key, undertaking a stock-take of acquired knowledge and practice in modelling and sharing this through a workshop, 'Modelling in the design, evaluation and extension of research and development' is recommended. The purpose is to share the learning from previous investments in modelling, to detail the strengths and limitations of various models and modelling approaches, to deliver better project planning and evaluation, and to improve delivery of information to end users (for example in a systems context).

Seven areas of research and development overlap where important linkages occur are outlined where there should be potential to capture synergies in RD&E funding and delivery. Capturing such synergies would mean fewer, large integrated investments based on a comprehensive program/project development process. While there is justification to emphasize that technical research and development should be conducted in a farm systems context, it is important that there is also a sound understanding of the principles applying in

the components comprising the biophysical system, and some of the areas will require component research. Development is necessarily inclusive of education and extension and investors should require all new projects (or programs) to have an extension/education component or to be linked to existing extension and education programs/activities, and that key extension and education stakeholders be involved in project development.

The seven areas of overlap are described under the following headings:

1. More efficient nitrogen use on dairy farms;
2. Water use efficiency;
3. Pasture plant improvement;
4. Cow genetics;
5. Dairy cow nutrition;
6. Transition cow management and nutrition; and
7. Access to data.

Overlaps with climate change and greenhouse emissions are highlighted within these seven areas. Comments made as to how benefits might be captured are the views of the author and should be checked with those who might be involved in these areas of RD&E.

## 2. Introduction

The Dairy Moving Forward: A National Research Development & Extension Strategy report (DMF 2009) provided the strategic context for the development of draft RD&E strategies for five strategic priority areas. The priority areas are:

- **'Feedbase & Animal Nutrition':** Developing the skills and knowledge that allow retention, management and utilisation of an internationally competitive feedbase in a changing climate.
- **'Animal Performance':** Improving animal performance.
- **'Natural Resource Management and Climate Change':** maintaining access to key production resources.
- **'Farm Business Systems':** Assisting farm businesses to adapt to a demonstrably more volatile business/ climatic environment; developing the skills of farmers to manage that volatility.
- **'People':** Increasing the skills and capacity of people; aggressively developing industry education and training options.

Preliminary outlines of the strategies for these priority areas were presented to the DMF steering committee in March 2010, with full drafts developed by September (DMF 2010).

Dairy farmers today operate in an increasingly complex environment and this will continue. Just as there are

interactions and linkages between the elements of the systems operated by farmers, it was recognized from the outset that there are integral linkages between the five priority RD&E areas. Within each of the draft strategies, linkages or areas of mutual interest are identified both between sub-strategies or priorities for future work within each of the five priority areas, and between priorities across the five areas.

The purpose of this discussion paper is to identify the key interactions (overlaps or areas of mutual interest) in three of the priority areas (Feedbase & Animal Nutrition, Animal Performance and Natural Resource Management & Climate Change) and to speculate on what these overlaps might mean in establishing priorities, in investing, and in capturing efficiencies when investing. The key documents used as the basis of the paper were DMF (2010) and 'Notes of a program leaders meeting on areas of clear mutual interest held on 23rd August 2010'. Within these documents, a more extensive list of interactions (i.e. exceeding the seven key areas listed in this paper) is identified.

While the remit of this paper was to focus on and clarify overlaps in the three technical priority areas, it is recognized that Farm Business Management and People are critical to the successful implementation of new and existing knowledge and technologies into farming systems.



### 3. A perspective of farming systems and farm systems research

*The biophysical systems of populations of farms are underpinned by common principles (for example in pasture renovation, in pasture production responses to fertilisers and in feeding cows). In addition important influences external to populations of farms can be common.*

*This means that the challenges and adjustment possibilities faced by managers of similar farm systems are not unique. However, the goals of farm families or management teams, their preparedness and capabilities to learn about and implement new knowledge or technologies, and their willingness to bear risk, do differ.*

*The importance of optimising many variables in a farm system means that improving a particular component of the system will not necessarily translate into improved performance of the business. As farm systems intensify, the effects of interactions between components of the system on overall performance become more important.*

*The interrelatedness of components of the biophysical aspects of farm systems means that there are inevitable overlaps within and between the Feedbase and Animal Nutrition, Animal Performance and Natural Resource Management and Climate Change RD&E priorities.*

*In setting priorities for RD&E it is important to recognize that the future is unknowable and that investment decisions (which have become more challenging) will be made with imperfect knowledge.*

*Investment decisions are made with imperfect knowledge and have become more challenging with the increasing diversity and intensification of farming systems. As complexity in dairy farming increases, the need for cross disciplinary RD&E grows. To capture the synergies where there are areas of mutual interest in the 'Feedbase and Animal Nutrition,' 'Animal Performance' and 'Natural Resource Management and Climate Change' strategies will require cross disciplinary research and development, may require both systems and component R&D, and will require integration with extension and education.*

*Capturing such synergies would mean fewer, large, integrated investments and these should be based on a comprehensive program/project development process.*

The content of this section has been derived in part from a draft paper by Malcolm et al. 'Lessons from a decade of dairy farm modelling in Victoria', with direct quotes included in parentheses.

It can be argued that dairy farm businesses are unique because the farm family or management team is unique in terms of their goals, psychological make-up, stage of life and capabilities. The resources [land (area and capability), water (rainfall and irrigation rights), infrastructure, labour, and herd characteristics] utilised in different farms vary and the development histories of businesses differ.

However, there are populations of farms where the biophysical systems are underpinned by common principles and important influences external to farms are common. Hence, the challenges and adjustment possibilities faced by managers of similar farm systems are not unique. As an illustration of this, the principles of pasture renovation, of pasture production responses to fertiliser application or irrigation practices and of milk production responses to feeding apply in farms with similar systems within a region. Some principles will apply across regions, but there are and will be inherent differences in the feedbase systems implemented on farms in the temperate, Mediterranean and subtropical regions and on rain fed or irrigated farms.

The impacts of important external forces on farms, such as market effects on prices received and paid causing a 'cost-price' squeeze, can be examined for populations of farms operating similar systems and supplying similar markets. However, there are again differences in external forces between groups of farms, for example in pricing for milk destined for a fresh milk market compared with that for milk for processing into export products.

Having highlighted there are commonalities in the biophysical systems on farms and in some external influences, it is important to reiterate that the goals of farm families or management teams, their preparedness and capabilities to learn about and implement new knowledge or technologies, and their willingness to bear risk, do differ.

Dairy farming is about managing change through time. Staying the same is not a sound economic option as the cost/price squeeze means reduced profit if productivity gains are not made. To adjust to changes in the operating environment and to remain profitable, farm managers endeavour to move the farm system over time onto new production functions. The significant changes farmers in Northern Victoria and the Riverina have made to their systems since 2002 to survive and then become more productive is a stark example of this. Learning is integral to decisions about change and is the primary basis of the 'People' and 'Farm Business Management' strategies in DMF. 'Some dairy farmer decision-makers may never be able to learn enough about a potential investment in change to make the decision to change – others will learn too little before they plunge in' (Malcolm et al. unpublished).

A better understanding of risk and uncertainty might enable dairy farmers to make more informed or better decisions when implementing changes to their system.

For example, when new technologies are introduced onto farms there is a time lag until the benefits are captured which relates to understanding and managing the change. In addition, while intensifying a farming system may increase the average profit, it is likely to also increase the variability in profit from year to year, meaning that improved skills are needed in managing risk and the new system.

To capture the benefits of new technologies, farmers need to have an understanding of the technology (learning) and be able to visualize how it fits in their system. Visualizing the systems fit of new knowledge or technology has become more difficult as variation and complexity in dairy farm systems has increased, with a general trend to more intensification. Farmers need to make sense of new technologies in their own context before they implement change. These people aspects introduce significant challenges in prioritizing investments and forecasting the impacts of RD&E.

An important challenge for those involved in technical research and development and those providing advice to dairy farmers, is that improving a component of the farm system will not necessarily translate into improved performance of the whole system. 'The behaviour of parts of a farm business, considered in isolation, cannot explain the behaviour of the whole farm business' (Malcolm et al. unpublished). Maximizing any partial productivity measure (e.g. pasture consumption per hectare, milk protein + fat production per cow or per hectare or milk protein + fat harvested per labour unit) will not maximize profit as the law of diminishing returns applies both in economics and biology. This has led to an increasing demand for technical research and development to be conducted in a systems context, to illustrate the importance of optimising many variables in the system as opposed to maximising a particular variable. As farm systems intensify, the effects of interactions between components of the system on overall performance become more important.

While there is justification to emphasize that technical R&D should be conducted in a farm systems context, it is important that there is also a sound understanding of the principles applying in the components comprising the biophysical system. Some of the priorities in the three strategies indicate a lack of understanding and a need for basic, component research. Without this understanding, it is not possible to visualize or understand the interactions and connections between system components, or to estimate where a farm is operating along a response function. In summary, if a component of dairy farm systems is poorly understood, it can be argued that component research to examine and understand significant input-output relations might be needed as a prelude to systems research and development. An example of this is partial mixed ration feeding, where there is little information in the international

literature on the effects of different amounts or types of mixed ration on pasture consumption and utilisation or on milk protein + fat production. Clearly, there is an important role for modelling to interpret or integrate component research in a systems context.

So what is farming systems research? 'Farming systems research solves problems or examines challenges by (i) investigating components of the whole system and their responses and linkages, the time effects and changes, and the risks and uncertainties, in operating farm systems over time, (ii) building understandings and explanations of the interactions, interdependencies and responses of farmers, farms, agriculture, markets, natural environments and social systems, and (iii) imagining, analysing and contemplating alternative futures for farm systems and their operators' (Malcolm et al. unpublished).

So what was the purpose of this section? The interrelatedness of components of the biophysical aspects of farm systems means that there are inevitable overlaps within and between Feedbase and Animal Nutrition, Animal Performance and Natural Resource Management and Climate Change RD&E priorities. In setting or suggesting priorities for RD&E it is important to recognise:

- the future is unknowable
- investment decisions will be made with imperfect knowledge (accurate forecasting of benefits is difficult)
- investment decisions have become more challenging with the increasing diversity and intensification of farming systems and a changing and more variable operating environment
- effective adoption of research and development outputs takes time and learning, that new knowledge and technologies may not be appropriate to all farm systems and even where the technology is appropriate to the system those operating farms may not have the resources, motivation or ability to adopt.

In summary, investment decisions are made with imperfect knowledge and have become more challenging with the increasing diversity and intensification of farming systems. As complexity in dairy farming increases, the need for cross disciplinary RD&E grows. To capture the synergies where there are areas of mutual interest in the 'Feedbase and Animal Nutrition', 'Animal Performance' and 'Natural Resource Management and Climate Change' strategies will require cross discipline research and development, may require both systems and component research and development, and will require integration with extension and education. Capturing such synergies would mean fewer, large, integrated investments and these should be based on a comprehensive program/project development process.



## 4. Gaining efficiencies from investments across strategies

*A robust development process will increase the value of RD&E investments and enable efficiencies where there are overlaps between the three strategies. Capturing synergies from the linkages will involve cross disciplinary RD&E and will mean fewer, large, integrated investments*

*Key principles of program/project development that are integral to success are:*

- *A common (agreed) understanding of deliverables between co-investors and with providers;*
- *Strong leadership and adequate resources for the development process;*
- *Budgeting properly for time, for people (including support staff), for practicality at a program and project level – providers and investors recognizing ‘a cost is a cost’;*
- *Integration of activities and relationship management take time and need to be recognized as an activity.*

*A superficial planning/development phase will diminish the value derived.*

### Scale of investments to capture synergies

A robust program<sup>1</sup> (or project) development process is considered the best way to capture synergies where there is overlap between research and development priorities in the three strategies. The nature of the priorities and the number of linkages suggest a program (as opposed to project) approach with linked modules (projects) will be needed to allow for the capture of synergies, but also to allow for a singular focus where required. It may be possible in some instances to design research and development activities that produce the outputs sought for more than one priority, while in other cases separate research and development activities will be required to deliver the outputs sought. It is important that the integrity, in particular the design, of research activities is not compromised by trying to address too many hypotheses (questions) at once. The priorities outlined in the strategies indicate there will be a need for both systems and component research and development.

Involvement of farmers, extension and education stakeholders in RD&E programs from the outset should ensure new knowledge and/or technologies are put into context for farmers, allowing them to make good decisions around what it means for them

and their farm from both a productivity and Natural Resource Management perspective. With extension and education, it is logical that materials and activities designed to improve knowledge and lead to change contain the underlying principles for both production and Natural Resource Management outcomes. As an example, education and extension concerned with feedbase production will usually implicitly cover agronomy (renovation, fertiliser, irrigation) and grazing management, but should also elucidate the linkages and implications for Natural Resource Management and cow nutrition.

Capturing synergies from the linkages in the three strategies will involve cross disciplinary RD&E and would mean fewer, large integrated investments based on a comprehensive program/project development process.

### Some principles of program development

A rigorous planning process applied to program development, and to the development of projects within, will be needed to ensure investments return value. The principles of program/project development/planning are well documented and understood. The points made below emphasize some of these that will be necessary in developing cross disciplinary programs.

The industry outcomes sought from each strategy are described at a high level and are of a general nature and the outcomes sought from programs of work (or projects) will need to be more specific (perhaps SMART—specific, measurable, agreed, relevant and time bound) to the planned work. This should enable the outputs required from RD&E and how they link to the outcomes sought to be more clearly defined. Clarity in understanding of the outputs sought from particular activities (pieces of work) between those investing and those conducting the RD&E is a key principle. It should provide administrative efficiencies in development and delivery of programs. Writing a project brief with clearly specified objectives and outputs is not easy. It is likely investors will have different priorities, their emphasis may be on different outcomes and, hence, they may require different outputs. This means that program development may need to include an iterative process where what is sought is reviewed as development proceeds leading eventually to a clear, agreed project logic.

A significant challenge, when funds available are finite, is to invest in programs at the level required to deliver value. The three strategies identify a large number of

<sup>1</sup> *A program is a number of linked projects all of which are required to deliver the outputs (knowledge, technologies, education, extension activities) needed to achieve the desired productivity, NRM, and social outcomes.*



priorities and there are significant risks if investments are spread in a way that leads to under resourced activities. Not budgeting properly for time, for people (including support staff), and for practicality will diminish the value derived. At the same time, it is inevitable that programs designed to deliver priorities from across the three strategies will involve several activities. Hence, it is imperative that each activity has defined outputs and a comprehensive work breakdown structure to ensure adequacy of resources and funding. This means that at least the first year of any activity needs to be fully designed in terms of tasks, time requirements from those involved and resources, without which costs are at best an estimate. Such depth of planning in RD&E is more the exception than the norm. This depth of definition will allow decisions on where more than one question can be addressed in an activity (to provide efficiencies), where separate activities are required (to ensure integrity) and on scheduling (particularly where the outputs from one piece of work are needed before others can proceed). Again this is important to achieving a clear, agreed project logic where the integration and sequencing of activities can be implemented in relation to funds available.

An important principle is that 'a cost is a cost'. As a simple example, in research it is important that there is replication to understand variation (and risk), that it

is peer reviewed to ensure the conclusions are valid and can be extended with confidence, and that it is published and so not lost in a filing cabinet to avoid the need to repeat the work.

Integral to the success of a robust development process will be strong leadership and adequate resources. It is apparent in each strategy that a large number of stakeholders have been identified as possible participants in the priorities identified. This is important to ensure diverse views and regional needs are considered as research and development delivery moves to a National framework. However, the reality is that following the development process some will have major roles in the implementation and conduct of the work, while others will not. For this reason leadership and consultation during the development process are crucial. It may be that program development leaders are not the eventual project leaders. The process should also identify and confirm the availability of activity leaders and skills that are critical to success.

Finally, broad programs of RD&E as outlined in Section 6 will provide best value where integration is treated as a specific activity with planned tasks that are costed and where the time taken in relationship management is acknowledge. It should not be treated as an add on after implementation.

## 5. The key role of modelling

*Modelling will be a key tool in the design and conduct of any cross disciplinary investment.*

*A stock-take of acquired knowledge and practice in modelling should be undertaken and shared through a workshop, 'Modelling in the design, evaluation and extension of research and development'. The purpose is to share the learning from previous investments in modelling, to detail the strengths and limitations of various models and modelling approaches, to deliver better project planning and evaluation, and to improve delivery of information to end users (for example in a systems context).*

*The industry needs to continue building capability and understanding of modelling and to better utilize modelling in guiding investment decisions.*

Modelling has become and will remain integral in the design, evaluation and extension of most research and development.

In relation to modelling, the question being asked best determines the approach to modelling and which biophysical models might be used. Modelling the

economic performance of whole farm systems presents challenges in integrating knowledge about the key response functions that are of a general nature to the amalgamated effects of these response functions combined into the whole farm system. This is further complicated by the need to account for people and important influences external to farms.

Dairy Australia and others have recently invested in a range of modelling projects, including Whole farm systems analysis and tools for the Australian and New Zealand grazing industries (WFSAT). This particular project had objectives of examining questions of strategic industry and investor relevance; developing capability in model users; and road-testing the integration of the Models. Program 3 of the DairyFutures CRC- Capturing the farm, factory and community benefits, will use modelling to examine the outputs of Programs 1 (Designer forages) and 2 (Animal improvement). For example, if you use molecular genetics to change forage quality in the feedbase, how does this change the performance of different systems?

It needs to be recognized that most existing models have limitations in relation to questions that are being asked by scientists and the industry. For example, Dairy Mod is considered a useful model in relation to feedbase production, and it has been calibrated against plot and field scale data. However, there have been instances, for example in the 30:30 project, where predicted levels of production of some crops were not achieved at field scale. Hence, while analysis from such models gives useful insights into what is possible, users need to be cognizant of the reality that the outputs are indications of what might happen and that not all farmers will achieve/capture the potential gains from technologies being tested.

Understanding the constraints in application of current cow nutrition models to pasture-based milk production systems is particularly important to their effective application. An example of this is given in Section 6.3. In many of the cross strategy priorities, modelling or modelling approaches will require multidisciplinary, interdisciplinary teams to examine the impacts of new technologies in representative dairy farm systems. That is the analysis will need to be informed by a range of scientific and economic disciplinary knowledge and practical farm management expertise.

As modelling is a key in the design and conduct of RD&E, undertaking a stock-take of acquired knowledge and practice in modelling and sharing this through

a workshop, 'Modelling in the design, evaluation and extension of research and development' is recommended. The purpose is to share the learning from previous investments in modelling, to detail the strengths and limitations of various models and modelling approaches, to deliver better project planning and evaluation, and to improve delivery of information to end users (for example in a systems context).

There is a linkage between priority C2 (Application of more 'sophisticated' characterisation of feeds to improve efficiency of conversion of nutrients to milk protein + fat) in the Feedbase and Animal Nutrition strategy and modelling. Better characterization of feeds used on Australian dairy farms is necessary to effectively use nutrition models and has the potential to improve decisions on feeding management. Early agreement on the suite of feed analyses required for use of models could be achieved quite quickly using the Dairy Australia's Nutrition Advisory Group and current 'expert' users of nutrition models. Analysis of selected well described samples from existing and new projects would then facilitate the development of an 'Australian feed library' and improved use of nutrition models.

Finally the industry needs to continue building capability and understanding of modelling and to search for improvements in how modelling might guide investment decisions.

## 6. Identified cross linkages

The areas of clear mutual interest within and across strategies that are considered below were identified from DMF (2010) and notes of the program leaders meeting on the 23rd August 2010. This is not a comprehensive listing of where cross linkages occur, but identifies important areas where it is believed joint planning can provide benefits and this could potentially guide investment decisions.

There are obviously other ways to cut the cake so to speak and the suggestions made in this paper should be seen as a 'straw man' for discussion. It is considered thorough project development processes will capture additional opportunities for efficiencies and examine the practicalities of research and development delivering the outputs being sought.

Development is necessarily inclusive of farmers, education and extension and investors will require all new projects (or programs) to have an extension/ education component or to be linked to existing

extension and education programs/activities, and that key extension and education stakeholders be involved in project development. Hence the focus below is on technical linkages in research and development.

### 6.1. More efficient nitrogen use on dairy farms

Cost effective nutrient use on farms is integral to feedbase production and responsible management of environmental resources. There has been increasing strategic and tactical use of nitrogen fertiliser to increase home grown feed production, particularly in the more intensive dairy farm systems. While there has been considerable investment in research and development in this area, gaps in knowledge remain. In the Natural Resource Management and Climate Change (NRM&CC) strategy, specific priority outcome 5 'Improved extension of nutrient management principles and practices to achieve a more rigorous objective approach to nutrient management at farm level' is focused on capturing

the benefits of these investments through a more coordinated approach to extension and education.

Priority outcome 4 in the NRM&CC strategy, 'Long term sustainable use of nutrients through greater understanding of nutrient pathways', has four specific priorities, namely:

- **D1** Analysis of nutrient transformations, in particular N,
- **D2** Microbial approaches for manipulating N and P
- **D3** Quantify the risks to the dairy industry from likely catchment, state, national and international regulatory requirements targeting off farm nutrient loss over the next 5 to 10 years, and
- **D4** A review to determine the knowledge gaps in the current understanding of where dairy nutrients end up in off farm sinks.

These priorities align closely with the research and development encompassed in the Feedbase and Animal Nutrition priority areas -- B4 (Maximising margins: minimizing foot prints) and to a lesser extent B2 (Improved strategic, tactical and operational decisions in relation to how particular forages fit in the feed production and feeding systems on farm). Priority B4 encompassed improved whole farm nitrogen use efficiency, through setting targets, identifying areas for improvement and quantifying the economic and social impacts of N use efficiency in a whole farm context. It also related to improved feeding system efficiency through better capture of dietary nitrogen within the animal leading to improved energy utilisation for productive purposes (D1). Priority Outcome 3 in the NRM &CC strategy 'Increased industry capacity to reduce greenhouse gas emissions' is also closely aligned with this area.

The research in these priorities could involve modelling to examine potential for improvements, fundamental research to understand soil microbial processes and C and N fluxes (and interactions), component research to examine grazing options to increase legumes in pastures, identification of mitigation options, broad scale on farm research and development and development of an on farm metric (i.e. nutrient accounting tool/model).

There is a clear overlap with the use of new germplasm (pasture or fodder crops) that might increase N fixation or improve N utilisation.

Research to improve N utilisation in the grazing cow will involve quite sophisticated nutrition/metabolism experiments and it is possible this aspect is best dealt with in a separate program of work as outlined in priority D1 (More efficient utilisation of N and carbohydrate from feed sources for optimised Feed Conversion Efficiency and milk protein + fat production) of the Feedbase and Animal Nutrition strategy. This comment is based on the practicality and costs of such research.

#### **Comments:**

**Efficient fertiliser use is critical to Australian dairy farms remaining internationally competitive, but increasing scrutiny of environmental impacts is inevitable. Hence, progressing RD&E in this area is a high priority.**

**Further development of these priorities from the two strategies should occur in concert.**

**It will be important to review the outputs from current and recent research and development as part of the development process.**



## 6.2. Water use efficiency

Changes in the availability, price and policies relating to irrigation water use present challenges for those running irrigated dairy farms, but also those using supplementary irrigation water. The need to achieve efficiencies in irrigation water use is clear.

Priority B3 (Improved use of irrigation water to reduce seasonal feed deficits) in the Feedbase and Animal Nutrition strategy overlaps with priorities proposed in Outcome 6 (Increased profit per unit of water use on irrigated dairy farms) in the NRM&CC strategy. The priorities in the NRM&CC strategy are:

- **F1** Identification and research into new dairy farm irrigation delivery and water management systems
- **F2** Development of crop modelling tools that can be used in a predictive sense
- **F3** Economics of investment in new on-farm irrigation infrastructure and irrigation methods, and
- **F4** Improved understanding of the economic role of water in a farm systems context.

There is a considerable body of recent and current research across these areas which should be analyzed in developing an RD&E program in this area.

### Comments:

Improved water use is important to the viability of many dairy farms meaning the RD&E proposed is high priority.

Further development of these priorities should be a joint activity.

It will be important to review the outputs from current and recent research and development as part of the development process.

## 6.3. Pasture plant improvement

The Dairy Futures CRC Program 1 (Designer Forages) is expected to produce cultivars with superior agronomic performance and with improved nutritive characteristics. Examples might be cultivars which exhibit advantages in nutrient uptake, in adaptation to variations in water supply, and in nutritive characteristics (e.g. higher sugar concentration and estimated metabolisable energy (ME) content). It is likely that evaluation of advantages in genetic material from the program will initially be through traditional pot or plot scale comparisons.

The benefits at a farm systems level will be evaluated in CRC Program 3 or by commercial partners using modelling approaches. Feedbase and Animal Nutrition Priority A4 (Evaluation of the potential benefits of forage plant cultivar improvements within dairy systems) forecasts there will be a need for research to confirm the agronomy, grazing management and environmental conditions necessary for expression of traits as well as interactions between new plant products and other components of the cow's diet in the context of different farming systems.

In modelling the benefits of plant improvement at a farm systems level, it will be important that the approach involves appropriate discipline expertise (e.g. agronomy, soil biology, ruminant nutrition) as well as practical know how from consultants and farmers as an expert panel to ensure assumptions made are sensible. The complexity of the modelling will depend on the trait, as it will be easier to examine the advantages of increased yield as compared to changes in the nutritive characteristics of plants.

Some existing models will have limitations in relation to the likely questions. For example, in an agronomic context, a feedbase model such as Dairy Mod is usually calibrated against data from plot and/or well managed field scale studies. While analysis using such models gives a useful insight into what might be possible, there are implicit assumptions that the agronomy, grazing management and environment will allow expression of the 'new' trait. It is also usually assumed that farmers can or do apply a high level of management.

Some questions will be more complex than others. For example, modelling the benefits of high sugar ryegrass at a farming systems level will require deep consideration of the assumptions made. While the estimated ME of such material (from laboratory estimates) may be higher, this does not necessarily mean the ME actually available to cows will be improved by the same amount. The interactions between grazed pasture and supplements in the diet modify the ME actually derived by cows

through associative effects in digestion. It is possible that higher sugar grasses could lead to greater diurnal fluctuations in rumen fermentation and an increased incidence of sub-acute acidosis in some feeding systems leading to lower than expected ME available to cows. Furthermore, it is also possible that increases in the soluble sugar concentration in grasses may lead to altered fermentation pathways that have implications for milk composition and functionality and greenhouse gas emissions. Commonly used nutrition models, for example CPM Dairy, would not be suitable for examining such impacts as they work on a daily time step, whereas it is the intake pattern and the amounts of pasture and supplements ingested that will determine the diurnal fermentation pattern and incidence of sub-optimal fermentation. More sophisticated models (e.g. Molly) require further development for use in pasture-based systems. The benefits (or otherwise) of new germplasm with altered nutritive characteristics are likely to differ between the five broad feeding system categories used by the industry.

The modelling of the three-way inter-relationship between Feedbase and Animal Nutrition, Natural Resource Management & Climate Change, and Animal Performance priorities are likely best dealt with in the design of Dairy Futures CRC Program 3 (Capturing the farm, factory and community benefits).

#### **Comments:**

The potential impact from new germplasm is high providing benefits can be captured at farm level. Until new germplasm is available and preliminary evaluations (in pot or plot work) are completed, it will be difficult to evaluate the benefits through modelling or field evaluation approaches. The timing of availability of new germplasm is not clear to the author.

The inter-relationships between plant breeding, agronomy, animal nutrition, animal genetics and natural resource management are likely to be examined through modelling as part of the scoping of Program 3 of the Dairy Futures CRC or by commercial partners. It will be imperative that the right mix of disciplinary and practical skills is involved in evaluating the benefits in different systems.

## **6.4. Animal genetics and reproductive performance**

There is a key overlap between animal genetics, reproductive performance, and NRM&CC through N excretion and methane emissions intensity. Animal Performance RD&E Priority 1 (Breeding herd that perform in Australian Conditions) and Priority 2 (Improve capacity for genetic improvement through genomic and reproductive technologies) both have the potential to significantly impact emissions intensity, overlapping the NRM&CC Priority C (GHG emissions).

Animal Performance Priority 2 (Theme 2: Extending genomic Australian breeding values to new and valuable traits) includes genomics research to improve breeding values and markers to new traits (for example feed conversion efficiency and fertility) that will impact enteric emissions and national greenhouse gas abatement strategies.

In addition to leading the development of new and valuable traits, the Dairy Futures CRC Program 3 will be used to determine further opportunities to reduce enteric methane emissions. It is likely the approach taken will be dependent on the trait. For example, the benefits of selection for fertility in different farm systems might be examined using modelling, while the benefits of improved feed conversion efficiency (FCE) might require modelling and experimental work. For example, if the, then it is likely modelling would be conducted to examine the impacts on production and environmental expression of high versus low FCE in young animals is confirmed when they are lactating and fed partial mixed rations benefits in different farm systems. It is also likely that controlled research might be required to examine whether expression of high FCE is maintained in other feeding systems and whether it is associated with feed intake, digestion or tissue metabolism. Such investigations of the biology might enable better targeting of genetics to different feeding systems or provide opportunities to take advantage of the unique biology.

Transition feeding has an important role in animal reproductive performance and is reflected in the interdependency of the Animal Performance Priority 1 (Theme 2: Improving reproductive performance) and Feedbase and Animal Nutrition priority (D2: Improved transition cow diets and management pre and post calving for higher production and improved cow health and reproduction).

A recent review undertaken by Dairy Australia's Grains2Milk and InCalf programs of the current Australian literature and practices to identify key principles/ influences on health, fertility and production of the



cow through management of the transition period has recently been completed by Ian Lean and Peter DeGaris. This has produced best practice management procedures that combine animal nutrition advice to nutritional professionals, veterinarians and farm advisers and will be incorporated into the InCalf fertility modules outlined in the Animal Performance Priority 1 (Theme 2: Improving reproductive performance).

Also envisaged in the priority was new research to quantify milk production benefits (independent of disease reduction) from better pre- and post calving nutrition and develop cost-effective methods of capturing these production benefits and those from improved health and reproduction. This research links to that proposed in Feedbase & Animal Nutrition priority activity (D1: More efficient utilisation of N and carbohydrate from feed sources for optimised FCE and milk protein + fat production)

#### Comments:

The potential impact from improved animal genetics is high providing benefits can be captured at farm level.

Scoping activities at the Dairy Futures CRC are being conducted to establish priorities for future work in particular capturing the benefits offered by improved breeding values and markers. This indicates these scoping activities should inform future investment decisions.

The inter-relationships between animal genetics, nutrition (inc feedbase), health and natural resource management are likely to be examined through modelling and it will be imperative that the right mix of disciplinary and practical skills is involved.

Improved reproductive performance impact herd profitability and natural resource management outcomes and are effected by nutritional and animal management practices. Good collaboration exists between nutritional and Animal Performance programs, but greater interaction with natural resource management programs should be developed.

## 6.5. Dairy Cow Nutrition

There are numerous overlaps between the feedbase, cow nutrition and cow genetics, management, health and welfare and natural resource management issues related to greenhouse emissions. The need for research in nutrition is justified by the conflicting beliefs amongst scientists and nutrition advisers as to the nutritional principles that apply in grazing systems, particularly the systems using higher amounts of supplements. This has left dairy farmers generally confused in relation to what they should believe.

Priority D1 (More efficient utilisation of N and carbohydrate from feed sources for optimised FCE and milk protein + fat production) of the Feedbase and Animal Nutrition strategy drives specifically at how to improve the efficiency with which feed is converted to milk across all dairy farm systems. This challenge is complex, particularly in systems where grazed pasture or forage is a significant component of the diet, and, hence in practice, is usually in separate meals to supplementary feeds.

Research into understanding how positive associative effects between feeds can be captured and negative associative effects can be limited is integral to improving feeding system efficiency, but it is also complex and expensive. A better understanding of issues such as:

- The impacts of different combinations of grains with different rates of fermentation and rumen retention times for high vs low producing herds/cows in different systems;
- The interactions between different feed combinations and stages of lactation; and
- The effects of different fibre sources on rumen retention times.

An understanding of these issues have the potential to deliver significant productivity improvements on farms. A common element to many of the nutrition questions is how to optimise rumen function in relation to ruminal starch and fibre digestion and microbial protein production.

Development of a research and development program in nutrition needs to consider carefully the practicalities (complexity and feasibility) of such research. It will be important the integrity of experiments is not compromised by trying to answer too many questions. This said it may be possible to examine linkages to animal health (Animal Performance) or methane emissions (NRM&CC) and nitrogen excretion (NRM&CC) without compromising experimental design as is being done in the flexible feeding systems research at Ellinbank.

This priority (D1) is also linked to priorities B2 (Improved strategic, tactical and operational decisions in relation to how particular forages fit in the feed production and feeding system on farms) and C2 (Application of more 'sophisticated' characterisation of feeds to improve efficiency of conversion of nutrients to milk protein + fat) in the Feedbase and Animal Nutrition strategy.

**Comments:**

The impact of improved knowledge in nutrition would be high.

This area of research and development is complex and sound experimental design is critical to success. In developing the detailed research plans it might be possible to value add through the measurements taken in experiments (e.g. animal health, milk composition and functionality, FCE, grazing management, methane and nitrous oxide emissions). However, integrity of the research is paramount to removing conflicting beliefs amongst scientists and nutrition advisers.

Requires a belief the cost of fundamental research will return value to the industry.

## 6.6. Access to data

The establishment of a centralised data repository was recommended in the Animal Performance Priority 4 (Investigate novel approaches to improve farm productivity via animal performance) to improve on-farm decision making, and improve data for research and development programs. These outcomes closely align with Feedbase and Animal Nutrition outcomes of Priority E (More effective tactical and strategic management decisions through timely, accurate and objective measurement of farm resources)

There was a desire expressed, particularly in the Animal Performance strategy, but more broadly at the program managers meeting, to capture much more detailed data from farms on feeds and feeding, animal performance (e.g. fertility) and management (e.g. transition cow feeding and management) and on the decision making process. It was envisaged there would be farm and national benefits that could be gained from an integrated data base which would link into a modelling capability, enabling better decision making.

In the Animal Performance strategy it is indicated the National Herd Improvement Association has been investigating the value proposition for improving data collection, quality and quantity, transfer and access in the Australian dairy industry. Other Dairy Moving Forward activities concerned with data collection include the Farm Business Management Strategy 2 (Good Tools – To ensure good quality 'tools' are used effectively and appropriately).

**Comments:**

Discussions between those involved in data collection and analysis may identify an approach to improve data collection, storage and access. The author is not in a position to comment on the likely value or costs.

## 6.7. Climate change & greenhouse emissions

RD&E in these areas has become more pressing from an industry perspective. Many of the priorities identified in the strategies are based on a more variable operating environment from a climate and policy perspective. Implicit in the linkages identified above are the need for farmers to operate with more variation in weather patterns, including extreme events (NRM&CC Priority B: Adaption to Climate Change) and to adopt technologies that can reduce their environmental foot print .

The key in project (or program) development will be to identify animal productivity, health and welfare (Animal Performance Priority 3) and environmental benefits or consequences of new knowledge and technologies. It will be important that greenhouse gas (methane and nitrous oxide) programs examine mitigation strategies in a farm systems context (NRM&CC Priority C: GHG emissions). Linkages have already been highlighted in sections 6.1 to 6.5.

## 6.8. Summary of crosslinkages (from 6.1 to 6.7 above)

Cross linkage	Feedbase and Animal Nutrition	Animal Performance	Natural Resource Management and Climate Change
<b>6.1. More efficient nitrogen use</b>	<b>B2</b> Improved strategic, tactical and operational decisions in relation to how particular forages fit in the feed production and feeding systems <b>B4</b> Maximising margins – minimizing footprints through whole farm nitrogen efficiency		<b>Priority C</b> – Greenhouse gas emissions <b>Priority D</b> – Nutrient use efficiency <b>Priority E</b> – On farm nutrient use efficiency
<b>6.2. Water use efficiency</b>	<b>B3</b> Improved use of irrigation water to reduce seasonal feed deficits		<b>Priority F</b> – Profitable use of water
<b>6.3. Pasture plant improvement</b>	<b>A4</b> Evaluation of the potential benefits of forage plant cultivar improvements within dairy systems CRC Program 3	<b>Priority 1</b> Breeding herds that perform in Australian conditions CRC Program 3	CRC Program 3
<b>6.4. Animal genetics and reproductive performance</b>	<b>D1</b> More efficient utilization of N and carbohydrates <b>D2</b> Improved transition cow diets and management	<b>Priority 1, Theme 2</b> – Improving reproductive performance <b>Priority 2, Theme 2</b> – Extending Australian genomic breeding values to new and valuable traits	<b>Priority C</b> – Greenhouse gas emissions
<b>6.5. Dairy cow nutrition</b>	<b>D1</b> More efficient utilization of N and carbohydrates <b>D2</b> Improved transition cow diets and management	<b>Priority 3</b> – Overcome issues and practices which impact on cow productivity, health and welfare	<b>Priority D1</b> – N loss through run-off, leaching, volatilisation and de-nitrification
<b>6.6. Access to data</b>	<b>E</b> Precision technologies	<b>Priority 4</b> – Investigate novel approaches to improve farm productivity via animal performance	
<b>6.7. Climate change and greenhouse gas emissions</b>		<b>Priority 3</b> – Overcome issues and practices which impact on cow productivity, health and welfare	<b>Priority B</b> – Adaptation to climate change <b>Priority C</b> – Greenhouse gas emissions

## 7. Accessing existing information for project development

An evaluation of existing information is critical in effective design of RD&E projects, and will be integral when developing programs (project) covering overlaps between strategies. The bulk of existing knowledge/information in many instances will not reside in peer reviewed publications, but will be in project reports that are not widely circulated.

As part of the development of the Dairy Moving Forward RD&E Strategy, lists of current and recently completed relevant research and development projects were compiled to facilitate discussions, identification of knowledge gaps and priorities by 'expert working groups' in workshops. The list was compiled from various sources including Dairy Australia, the Grains Research and Development Corporation, the State Departments and

project leaders. While the brief summaries gave a broad picture of recent research conducted in various areas, greater detail on what was achieved and the industry implications could be obtained by accessing the reports and publications from each project.

It was apparent at the workshops, that 'expert working groups' were not always aware of research and development relevant to their interests that was conducted elsewhere. Also the listings were not comprehensive, as commercial research projects may not have been included. Private sector participants indicated that a great deal of valuable information from field testing research was not readily available, and it would be valuable for the industry to invest in capturing this on an on-going basis.

## References

DMF (2009) The Dairy Moving Forward: A National Research Development & Extension Strategy report (September 2009)

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Notes of program leaders meeting on areas of clear mutual interest, 23rd August 2010.

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